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PRACTICAL APPROACH TO THE STUDY OF STONES IN GLASS

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Introduction

A stone investigation is primarily a detective job. The clues may be somewhat limited although, as in the dime novel, there are usually a number of suspects. It is generally quite easy for the petrographer to assemble these clues and to classify the stones as to their basic types, but it is often extremely difficult or even impossible for him to state with a fair degree of certainty where the stones are coming from.

The petrographer's task may be quite difficult for many reasons: (1) The measurement of certain optical properties of crystals are subject to uncertainty when these crystals are completely imbedded in glass; (2) Many of the crystals found in stones appear in a large variety of forms, and it may be difficult to penetrate these disguises; (3) Troubles are encountered when only a small part of an object can be seen, and one must guess at what the original object looked like; (4) In many cases, temperature or time can produce the same solution effects thereby complicating the problem of locating stone sources.

Knight[1] and Taylor and Hill[2] offer excellent suggestions on the techniques employed for stone investigations and Fabianic,[3] Holland and Preston,[4] Horak,[5] Thompson,[6] and others give considerable data to assist in interpreting the observations made. There are certain gaps in this published information, nevertheless, which this paper attempts to fill.

Suggestions for the Furnace Operator

The furnace operator holds the key to quick training for the petrographer, and it is essential that mutual cooperation and understanding be developed between these people.

(a) Sending Data with Stones. It is essential that adequate data be included with the stones submitted for microscopic examination. A system is described below which is in use successfully in one case wherein a centrallized laboratory, which is separated geographically from the plants, provides the stone service.

Each furnace supervisor has a pad of printed forms with blanks to be filled out furnishing the data in Table I. Such a form is filled out and sent in to the laboratory with each lot of stones. The usage of this information is briefly discussed below.

The cataloging data are useful for correlating the occurrence of the stones with operational data and are quite necessary for a historical file on stones. On the other hand, the so-called "Urgency Data" is primarily used to serve as a guide as to whether extra manpower or overtime work is warranted or if the investigation is obviously for historical purposes, in which case such extra efforts are not necessary.

The most valuable information for the diagnosis of the stone problem is listed as "Diagnostic Data" in Table I. Pertinent details of the stone occurrence are included here, as well as production information which relates to the stone problem. The type of data sought here would depend upon the product manufactured and this portion of the form would have to be tailored to meet the conditions at hand.

Details of the stone occurrence may provide valuable clues as to the source of the problem. Thus if the stones are coming from all tanks (with the plants which have several furnaces using the same batch), a batch error or a batch contaminant is suspected. If the stones are coming from one production unit and not from the others, a source near this machine will be suspected since generally the closer the source is to the machine, the less scattered will be the stones. In many manufacturing processes, the appearance of the stones in a particular location in the product may also serve as a guide as to their source.

The data on significant furnace changes and repairs are essential in providing knowledge of the types of re-

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TABLE I

Data to Be Submitted With the Stones

A. Cataloging Data
   1. Plant
   2. Furnace
   3. Machine
   4. Date of stones
   5. Time of occurrence
   6. Number of samples submitted

B. "Urgency Data
   1. Are stones still appearing?
   2. Approximate production loss per day
   3. Date samples sent to laboratory
   4. Has flurry been abrupt or gradual (give dates)?

C. Diagnostic Data
   1. Stones on all tanks?
   2. On all production units on the tank?
   3. Evenly distributed in the product?
   4. Any significant furnace changes or repairs?
   5. Suggestions as to their source.

fractories in various locations. If the petrographer is not kept abreast of changes made, it will be impossible for him to locate the source of the difficulty beyond making general statements as to the basic types of stones present.

Quite often the operator has an idea as to the source of the stones and can be very helpful in furnishing this information. Such information is valuable in that it often points out features that should be watched out for when sectioning the stone, but it does not influence the final results since the identification of the stone speaks for itself.

Fig. 1. Hot plate for petrographic work.

Fig. 2. Stainless steel slide holder.

(b) Stones from a Known Source. The furnace operator can be of great service to the petrographer, and hence to himself, whenever he can send in stones from a fairly well-defined source. Thus, if a piece of aluminous refractory is dislodged in the melting end and stones come through in the glass, such stones, with a complete history, will be of tremendous value to the petrographer in building background information on the rates of changes of the various refractories under the operating conditions at hand.

(c) Criticism of Final Report. The operator can be helpful too, if he will return a complete criticism of the final report. If he finds evidence later which agrees or disagrees with this report, he should make such evidence available to the petrographer. Such cooperation helps to improve the caliber of the petrographic service.

(d) Detailed Directions for Sending in Stones. An attempt has been made below to give some specific directions for submitting stones to the laboratory. Individual cases vary so widely that these generalized instructions may not always apply, but they will serve as a broad guide.

(1) *Number of Stones.* If only one or two stones are submitted, it is necessary to be quite careful in handling them and, accordingly, they take about as much of the petrographer's time as would a dozen samples. For this reason it is preferable to have at least 18-24 stones submitted in a lot, if it is convenient to gather such a number. Having a large number of samples helps to indicate the different stages of development of the stones and permits an estimation of the distribution by types. This latter point is especially important since it is not uncommon to have 4 or 5 distinct sources present in a group of two dozen stones and the problem may have to be handled from a statistical approach.

(2) *Selection of Stones.* Quite often the person collecting the stones may inadvertently select special stones. He may select those which are large in size, for example, since he might feel that these are easier to work with and to identify. Actually he would not be helpful to the petrographer by such a selection, and it would be far better if every stone coming through for a selected time period is taken to make up the sample, because thereby the petrographer gets a good cross-section of types and sizes. Of course, sometimes there may be a particular type of stone that the operator is interested in, and he doesn't want to include the "mine-run" variety. In such a case, the stones should be marked as "Not Selected at Random."

(3) *Amount of Surrounding Glass.* The petrographer does not need much of the surrounding glass beyond the requirements for ease in handling during the preliminary examination of the stones. If a cordy area is present, generally this should be included for examination. With flat glass samples, it is convenient to have about a two-inch square of glass.

(4) *Marking.* The samples should be properly labelled —preferably with a diamond pencil—if they are taken from different machines, or at different times. This may seem to be a trivial point, but there have been cases where it took about as long to decipher the smeared wax pencil markings as it did to identify the stones.

(5) *Wrapping.* There may be a tendency in the plants to give little value to a defective product and, therefore, to handle samples containing the defects carelessly. When

Fig. 3. Silica refractory stone, probably from refining end.

Fig. 4. Silica refractory stone, probably from melting end.

most of the stones are submitted by mail, it is important that they be wrapped reasonably well and in separate papers so that they are not broken during shipment. Breakage of the samples increases the difficulty of the preliminary examination and may distort the distribution by types.

Suggestions for the Petrographer

(a) Preliminary Examination of the Stones. The petrographer usually has a difficult task facing him, and he needs to use every clue available. Before sectioning any of the stones, it is often wise to collect data on their appearance. Taylor and Hill[2] point out very thoroughly how the appearance data, such as color, texture, associated cords, strain in the surrounding glass, and the presence of cracks or bubbles, may be interpreted and it is unnecessary to elaborate on their observations.

Generally, it is pertinent to classify the stones into groups according to some of the above appearance characteristics, especially by the strain in the surrounding glass, and then to examine the groups using the petrographic microscope, make preliminary opinions as to the types present, and finally to make thin-sections of some of the stones in each group.

Many petrographers are quite successful in using powders instead of thin-sections. The powder technique is very valuable in identifying phases, and may be preferable when examining stones of completely unknown history, but when the possible sources are limited and identification of phases is not a problem, better broad conclusions of sources can usually be formed by examining the structures in thin-sections.

(b) Slide Making. There have been many complete descriptions of the thin-sectioning technique and it is not the purpose of this paper to describe the method in detail but rather to point out means of facilitating such work. The thin-sectioning is accomplished by grinding through the center of the stones on a rough power-driven steel wheel using a wet slurry of 120 grit silicon carbide abrasive, after which the face is dressed down using successively finer grades of silicon carbide. The use of aluminum oxide abrasives is avoided since corundum may be present in the stones and there may be some uncertainty as to the source of a corundum crystal found in the slide if aluminum oxide abrasives were used.

The samples are then cemented onto glass slides—the ground surface next to the slide—using a cement such as Canada Balsam. A long hot plate such as is shown in Fig. 1 is helpful in handling several slides at a time. This home-made hot plate consists of two strip-heaters mounted beneath a copper plate with a bimetallic thermostat in the chamber below. The top surface is purposely made a little narrower than 3″ so that the slides will project over the edge for convenience in handling. The slides are numbered using a serial number for each group of stones, plus a consecutive number for each slide. The number is scratched on the back side of the slide using a diamond pencil.

It is usually advisable to examine these stones with the microscope after cementing them on the slides. Often the sample will be of uneven thickness and this optical distortion may be eliminated by using a brass ring (¼″ thick, 2″ in diameter) on the microscope stage and inverting the slides for examination. It is convenient to

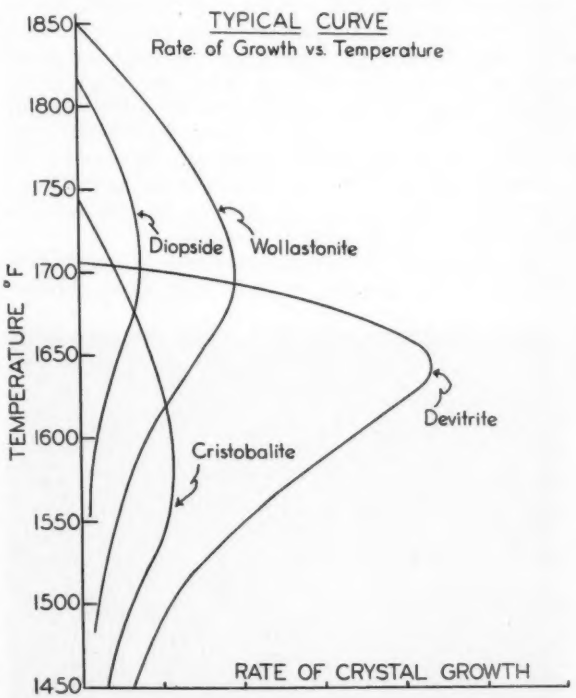


Fig. 5. Typical rate of crystal growth vs. temperature curve for window glass.

start classifying the stones as to types as early as possible and to work with decreasing numbers of classes in order to minimize labor.

A special device may be used for holding the slides while the samples are being ground down on the power-driven wheel. A suitable holder, shown in Fig. 2, can be made up of stainless steel and is designed so that the slide rests in the area provided being held in place by the surface tension of water. By such a means it is possible to watch the progress of grinding and to stop when the balsam starts to be ground away, which is usually at about 0.01″.

The thin-sectioning may be completed by grinding on glass plates using the same abrasives as before. The work may be speeded up considerably by using micrometer calipers now and then so that extreme caution is unnecessary during grinding. Usually with silica stones a thickness of 0.006 to 0.008″ is satisfactory while with aluminous stones it is necessary to go to thicknesses of 0.004 to 0.006″ or even as low as 0.002″ to permit the complete structure to be seen adequately.

Experienced petrographers usually examine the slides from time to time at various stages during the thin-sectioning process, make notes as to the contents, and stop when convinced of the results. It is rarely necessary to finish the slides unless a particularly interesting sample is found which will make a valuable specimen to add to the slide library.

(c) Identification of Phases. The identification of the phases present in the stones eventually becomes a process of recognition with perhaps one or two optical tests to verify the results. The petrographer will find that it will be advantageous to use a standard magnification (about 75X) for most of his observations so that the sizes of the crystals are apparent to him at once, because some of the source diagnosis is based on the relative crystal sizes.

(d) Interpretation. After the various phases are identified, the petrographer is faced with the most interesting part of this type of work—deducing the source of the stones. He will be wise to draw heavily on the literature but should, however, be able to temper the remarks in the literature to suit the existing conditions. He should be acquainted with all of the refractories in use and, through postmortem observations on furnaces, should learn the places where the corrosion is greatest.

The literature on aluminous stones is particularly comprehensive with the many valuable papers already referred to.[1-6] The author is unable to add further information on that subject. However, certain observations made by this laboratory on silica and devitrification stones may be of interest and are discussed below.

Repeated attempts were made trying to locate the source of silica refractory stones based on the relative amounts of cristobalite and tridymite present and the relative sizes of these crystals, but it was finally concluded that there is more variation in structure between adjacent silica bricks than there is in bricks from one end of the tank to the other. It was found, however, that often there is a zone of solution and recrystallization around silica refractory stones from the melting end, while stones from the refiner, having been in the glass for a short period, do not show this. To illustrate, in Fig. 3 a clear-cut boundary is evident between the silica refractory and the glass indicating that this particular silica refractory stone probably had a late entry into the glass. On the other hand, Fig. 4 shows a "pine-tree" growth of cristobalite crystals growing around a silica refractory stone which probably came from the melting area.

While devitrification stones are mentioned only casually in the literature, there are two methods by which the petrographer may be able to fairly well define the source. The first method consists essentially of making a complete study of the crystallization behavior of the glass so that this knowledge can be used to deduce the temperature of crystallization of the devitrified glass encountered in practice. Thus, if the crystallization rate studies are made on a soda-lime-magnesia window glass by methods outlined by Swift,[7] it will be found that four phases grow at different rates, depending on the temperature, yielding such a rate of growth vs. temperature diagram as shown in Fig. 5. Then if this glass tends to crystallize during production, the types of crystals present and their relative sizes may be used to give an indication of the approximate temperature at which the crystals grew, assuming that the crystallization in practice occurred in a narrow temperature range. Thus, if the glass which has a rate of crystal growth curve similar to Fig. 5 crystallizes, and it is found that the crystals are all wollastonite, one can conclude that the crystallization occurred at some area in the furnace where the temperature was 1820°F.-1850°F. On the other hand, if it is found that all four phases are present, the crystallization undoubtedly oc-

(*Continued on page* 220)

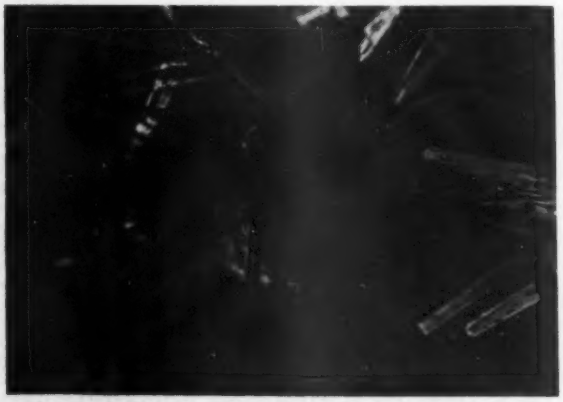


Fig. 6. Wollastonite crystals which are growing in size.

Fig. 7. Wollastonite crystals which are dissolving.

THE A.C.S. RETURNS TO NEW YORK FOR ITS 55TH ANNUAL MEETING

In 1950 the American Ceramic Society held its Annual Meeting in New York City. This year it has again chosen New York as the scene of its 55th Annual Meeting. Using the facilities of the Hotel Statler for headquarters, the Society's membership will be in session from April 26 through 29. Registration will begin Sunday morning, April 26.

More than 180 technical papers have been scheduled for presentation before the eight divisions of the Society. Arrangements for the activities of the Glass Division are in charge of W. H. Manring of The Calumite Company; Basic Science Division activities are in charge of H. F. McMurdie of the National Bureau of Standards; and the Refractories Division arrangements are in charge of L. R. McCreight of Knolls Atomic Power Laboratory. Aside from the technical meetings, several dinners have been scheduled and the general entertainment will include a floor show and dance on the night of April 27.

Included in the five sessions to be held by the Glass Division are eighteen technical papers. Of special interest will be an audience-participation discussion on the subject of convection currents in glass tanks. Larry Penberthy, Penberthy Instrument Company, will present a paper entitled, "Are Convection Currents Good?" Mr. Penberthy has found, contrary to popular theories, that convection currents are undesirable in glass tanks and is prepared to defend his position.

H. R. Lillie of Corning Glass Works will present a re-evaluation of glass viscosities at the annealing and strain points. Mr. Lillie proposes that, in view of modern experimental equipment and methods and certain corrections for expansion and temperature measurement, a modification of these standard and accepted definitions is in order. He will put forth a recommendation regarding definitions that might be internationally acceptable.

Leo Shartsis, Webster Capps, and Sam Spinner, from the National Bureau of Standards, have collaborated to present the paper, "Viscosity and Electrical Resistivity of Molten Alkali Borates."

Glassmaking apparatus and equipment will be featured in papers by Earl Flatter, Overmyer Mould Company, who will speak on "Mold Irons and the Glass Mold Situation"; C. L. Roberson, Owens-Corning Fiberglas Corporation, "An Instrument for the Measurement and Control of the Level of Molten Glass in Tanks"; J. R. Green, Minneapolis-Honeywell Regulator Company, Brown Instruments Division, "Automatic Control of Glass Forehearths"; and Paul Close and M. T. Watson, Jr., Owens-Illinois Glass Company, "Determination of Potassium in Glass with the Hydrogen Flame Photometer."

New developments in copper-silver stains will be discussed by O. S. Levi, of the Verd-A-Ray Corporation F. R. Bacon and C. J. Billian, Owens-Illinois Glass Company, will present a paper on the color and spectral transmittance of amber bottle glass. The subject of iron colors in sulfur-free glasses will be presented by Valjee Suraiya and S. R. Scholes from Alfred University. F. C. Raggon and F. R. Bacon have collaborated to present a discussion on the action of HCl solutions on borosilicate and soda-lime glass bottles. Mr. Raggon and Mr. Bacon are from the University of Toledo and the Owens-Illinois Glass Company, respectively.

E. B. Shand, Corning Glass Works, will discuss his experimental studies on the fracture of glass. Another paper on the strength of glass will be presented by D. A. Stuart and O. L. Anderson, Cornell University and Bell Telephone Laboratories, respectively. Their paper is entitled "A Flaw Distribution Function and Its Implications."

The efficiencies of several types of plate glass for shielding against atomic radiations were investigated by

the Pittsburgh Plate Glass Company and the results will be presented in a paper by K. M. Laing and J. J. Bonino of that company.

O. L. Anderson, Bell Telephone Laboratories, will present a discussion of the diffusion of silica in glass. Two papers on vitreous silica will also be presented: "The Specific Heat of Vitreous Silica," by H. T. Smyth, Rutgers University, and "Coexisting Structures in Vitreous Silica," by C. L. Babcock and W. W. Barber, Owens-Illinois Glass Company, collaborating with Kasimir Fajans from the University of Michigan.

Prof. Emeritus Alexander Silverman of the University of Pittsburgh's Department of Chemistry will discuss sources of illustrative lecture material of the pictorial, material, and experimental type.

The program will be concluded with a business meeting of the Division.

The Basic Science Division will hold four sessions and will present twenty-six papers. In addition, five papers will be presented in a joint meeting with the Refractories Division.

Papers to be included in the joint session include: "Measurement of Thermal Conductivity at Elevated Temperatures," by W. D. Kingery, M.I.T.; "The Effect of Porosity on Thermal Conductivity of Refractories," by J. Francl and W. D. Kingery, M.I.T.; "Thermal Strain During Firing of a Ceramic Body," by S. P. Mitoff and J. A. Pask, University of California; "Measurement of Thermal Conductivity of Single Crystals," by Edwin Ruh of Rutgers University; and "Examination of Refractory Specimens in Reflected Light," by R. B. Snow, U. S. Steel Corporation.

The Design Division has scheduled twenty papers and a round-table discussion for presentation at its five sessions. Among the papers to be presented which may be of interest to glassmen are papers by Alfred Duhrssen, President of Commercial Decal Company, who will discuss changes in consumer taste within the past 25 years; Walter Browder, Editor of *Crockery & Glass Journal*, will discuss the desires of today's customers and how to meet them; "Modern Stained Glass—Craft of the Middle Ages Meeting the Challenge of Our Modern Idiom," will be the title of the paper by Robert Rambusch, Rambusch Decorating Company; John B. Ward, Director of Design at Corning Glass Works, will discuss industrial glass.

Thirty-one papers will be presented in the five technical sessions of the Refractories Division. A feature of the program will be a session on special refractories and cermets. Several papers of interest to glassmen will also be presented by this Division. A. W. Allen, University of Illinois, will review the application of sonic moduli or elasticity and rigidity to the testing of heavy refractories. Some effects of titania on refractory clays will be discussed by C. M. Dodd and D. R. Wilder of Iowa State College. E. A. Thomas and R. W. Knauft, of Chas. Taylor Sons Company, will review developments in zircon refractories for the glass industry. Special reference will be given to grain structure, chemical reaction, and dissociation of zircon refractories in regard to service. Some physical properties of chromite-magnesite refractory mixtures will be discussed by P. G. Herold and T. J. Planje, Missouri School of Mines.

In addition to the technical program, several other events have been planned. Frederick R. Matson will present the Edward Orton, Jr., Fellowship Lecture. Since the Fall of 1948, he has been a Professor of Ceramics at Pennsylvania State College teaching graduate and undergraduate courses in petrography, silicate chemistry, and ceramic raw materials. Dr. Matson received a B.Sc. in ceramic engineering in 1933 from the University of Illinois. After studying mineralogy at the Carnegie Institute of Technology, he accepted a University Fellowship at the University of Michigan, where he remained until 1936. In 1938-39, he was a Predoctoral Fellow at Rackham School of Graduate Studies, University of Michigan. He has studied ceramic collections and exhibition techniques in Europe and was in charge of the excavation of an ancient temple and theater near Bagdad. Remaining at Michigan until 1942 as assistant curator of ceramics in the Museum of Anthropology, he went to the National Bureau of Standards in that year to do development work on optical glass manufacture. Two years later he joined the Armstrong Cork Company as head of glass research, and remained with the company until joining the Penn State faculty.

The Student Speaking Contest at the meeting will be held Sunday evening, April 26. First prize will be $15 and a one-year American Ceramic Society membership. Second and third prizes will be $10 and $5, respectively, and one-year Society memberships. Fourth prize will be a one-year Society membership.

The Ross Coffin Purdy Award and the Binns Medal Award will be presented at the General Banquet. The Purdy Award is given for the outstanding contributions to ceramic technology and the Binns Medal is presented each year by former students of Charles Fergus Binns for the best example of ceramic design or ceramic art produced in the previous year.

Serving on the General Committee are: Chairman, H. B. Dubois, Consolidated Feldspar Corp.; John F. McMahon, New York State College of Ceramics; Charles R. Ambert, Alfred University; Jo Gitter, Whittaker, Clark & Daniels; George C. Betz, Metal & Thermit Corporation; George T. Morse, Metuchen, New Jersey; and Irwin F. Zeiller, B. F. Drakenfeld & Co., Inc. Howard Lanin is arranging the entertainment for the meeting. James E. Gheen is scheduled to give the banquet speech Tuesday evening.

No preprints are planned for the New York meeting. Plant trips and trade exhibits are not scheduled.

Because of the wide range of entertainment facilities to be found in New York, no program has been planned for the ladies attending the meeting.

OWENS-CORNING ELECTS NEW BOARD MEMBER

William J. Murray, Jr., Chairman of the Board of McKesson & Robbins, Inc., has been named to the Board of Directors of the Owens-Corning Fiberglas Corporation. Mr. Murray was chosen to fill the term of Robert T. Stevens, who has resigned to accept appointment by President Eisenhower as Secretary of the Army.

Mr. Murray became President of McKesson & Robbins in 1941 and later was named board chairman of that company. He first became associated with the firm in 1929 as a Vice President.

THE STATUS OF THE WEST GERMAN GLASS INDUSTRY IN 1952

Editor's Note: The following review is based on the extensive series of articles published in the special 1952 glass issue of the German newspaper on economics, "Volkswirt," (Issue 5, 1952), Frankfurt/Main. The articles are by leading German glass industrialists: E. Kukat, O. Seeling, W. Staudt, H. Ahrenkiel, N. von Buelow, G. Schmidt, R. Steiner, H. Richard, P. H. Peters, S. Palgen, M. Mazzarovich, H. Witte, G. Peter, F. Bruene, R. Suessmuth, L. Kratz, H. Brockmann, B. Hefter.

Drastic Changes in Location and Character

Zonal Distribution. In 1945, only 80 of the 190 glass factories of pre-war Germany, minus the Saarland and the lost Eastern provinces, were located in the Western zones of occupation. Most of these factories were in the states Rhine-Westfalia, in the British, and Bavaria, in the U.S. zone; and only very few in the French zone of occupation. Since 1945, a large number of new plants has affected the distribution. However, the centers of gravity have remained in the indicated areas. Most of the newer plants are small enterprises devoted to the production of hollow ware and special glasses. Therefore, the present distribution is better evaluated in terms of production than of numbers of plants. We find nearly 75% of the production in the British zone, mostly in the Ruhr district, and nearly 25% in the American zone.

Reconstruction and Change of Specialty Distribution. The initial problems of reconstruction were quite different in the various branches of the industry. The physical reconstruction of the glass plants and the satisfaction of the enormous demand for windows and containers were the first questions. However, this phase did not extend too long as the critical shortages were material and mechanical. The re-creation of an industry concerned with hand processed glass, especially in the fields of illumination and technical glass, took more time and effort. Almost all factories engaged in these branches of glassmaking happened to be located in the East. The foundation of new companies and, in part, the fast expansion in volume and scope of existing enterprises was a matter of necessity, but, in turn, it facilitated the relocation of skilled refugees of which there were many.

Population Changes. An additional production problem soon arose from the enormous increase of demand due to the absorption of 9,000,000 people expelled from the East among 39,000,000 West Germans in the relatively short post-war period. These changes correspond to an increase of density from 400 to 500 people per square mile.

Redistribution Problems. The rapid influx of new industries was bound to be accompanied by poor features of redistribution. Local and short-range decisions often prevailed over long-range policies, and each decision had to be filtered through the mechanism of military occupation authorities. Therefore, doubtful investments could not be avoided. However, since 1948, the currency reform remobilized purchasing power and export started to rise at the same time.

Organization. From the German viewpoint, proper economical organization was delayed by the Allied prohibition of central forms of organization. In the British zone, the creation of an Advisory Committee for Glass, and later of the Central Economic Office in Minden, soon reversed the original trend by the actual function of these zonal authorities as economical and industrial associations of the industries. In the American zone, however, Hessian and Bavarian organizations were ordered to remain separate. In 1949, French zone industries affiliated with the Bavarian group, and in 1950 all zonal and state organizations of the West German glass industries formed a Working Executive which appears to have become the equivalent of a Federal Association. Its president is E. Kukat, whose article is the largest single source of this review.

Production Almost Doubled

Total. In 1936, all Germany produced 730,000 tons of glass for 67.3 million people. Of this amount, 450,000 tons were made in the present territory of the Federal Republic (Western Germany).

In 1948, the U.S. and British zones produced 414,000 tons. The French zone does not appear in this particular number, but its production is not important by comparison.

In 1950, the production of all three zones was 788,000 tons, and in 1951, probably 900,000 tons, i.e. twice the amount produced in the same area before the war, and much more than the amount produced by all pre-war Germany which had a population of 67 million, compared to 48 million now living in the three western zones.

Relation to Other Industries; Relation to Hollow and Flat Ware. The glass industry represents only .7% of the total production of West Germany, but its relative progress is remarkable. The 1951 index of all industrial production (1936 = 100) was 136. The index for the glass industry, 201, is far ahead of this mean index. In the glass industry the hollow glass industry (index 229) surpasses the flat glass industry (181). This difference is due to the fact that in 1950 the recession affected the hollow glass industry more than the flat glass industry. The following ("Korea") recovery again favored the container industry.

Production in 1000 ts.

Year	*All*	*Hollow*	*Flat*	*Note*
1936	727	443	284	All Germany
1947	329	149	180	Two West Zones
1948	414	203	211	Two West Zones
1949	716	383	332	All West Zones
1950	788	443	344	All West Zones

Employment

Increases Disregarding Mechanization. Employment in the glass industry increased in the area of the present Federal Republic from 45,000 (1936) to 55,000 (1952). This development is remarkable as the mechanization in this period was considerable and employment in many of the new small industries was not covered by statistics.

Export

Soaring. Characteristically, Germany stresses the export of glass, direct and—in the form of filled beverage bottles, preserves, pharmaceuticals, optics, and automotive products—indirect, although the increasing importance of inland markets in the global economy has become apparent. In 1913, Germany exported 30%, in 1936 17%, in 1950 6%, in 1951 14% of its glass production. (This 14% represents 120,000,000 marks.) This percentage is slightly above that of all industries. (Glass production was .7% of all production, glass export .9% of all exports.) It is notable that this percentage means a larger absolute export volume than before the war. Sixty-six and eight-tenths per cent of the exported glass was finished product.

In responsible circles of the German industry, the dangers of the pre-war policy of pernicious international competition based on government subvention is well recognized. Some of these practices, and, conversely, national and international trusts, are impossible under present German as well as occupation legislation. The German glass industrialists strongly advocate fairness in international competition. Up to the most recent time, a very basic factor controlling export potential was the allocation of coal and here the glass industry continued to use the argument that glass creates currency because of its independence of imported raw materials and, therefore, deserves coal priority.

Interzonal Trade and Smuggle

One Way: East to West. The sudden separation of areas specializing in different branches of production made interzonal trade a vital requirement of the economy of the first post-war years. In the glass industry, the concentration of illumination, chemical, and optical glass in the East particularly favored the zonal importation of glass from the East in the over-all interzonal barter. Therefore, in 1950 3% of all goods imported from the Eastern zone was glass, while, as mentioned before, the percentage of glass in the total production was only .7%. This 3% represents about 12,000,000 marks. From the Eastern viewpoint, too, glass represents a non-strategical and expendable commodity.

Glass is used in the black interzonal trade as a means of currency manipulation; in other words, it buys Western goods not provided for in barter agreements. For this purpose glass is smuggled into the West, sold below price, and the acquired Western currency used to buy goods for the return trip. The price formation in the East is of course manipulated. In 1950, 100 tons of glass and porcelain were seized by Western authorities which obviously represent only a fraction of the actual black market imports. A good estimate of those imports is 12,000,000 marks, i.e. as much as the legitimate importation.

This stream of 24,000,000 marks worth of glass is compensated only by a trickle (375,000 marks) of glass export from the West to the East, and the Western glass industry presses for some adjustment of this situation.

Research and Technical Societies

Well Founded But Need Encouragement—The status of research in the glass industry is viewed with critical attention in all manifestations in which the German glass industry is heard in public. In this endeavor it can rely on two organizations which both as such and in the persons that have leadership have survived from pre-war days. The plants are organized in the "Hüttentechnische Vereiniguns (HVG)" (Glasshouse Engineering Union) which represents a unique pool exchanging plant experiences, salarizing a central staff providing information, and financing research as seen fit within or without ceramic institutions. This organization is still led in an individualistic manner by its founder, Dr. H. Maurach, in Frankfurt. In the same offices is located the "Glastechnische Gesellschaft" (Glass Engineering Society) in which mostly individuals interested in glass are associated, and which furthers technology by the issuance of the *Glastechnische Berichte,* the famous Committee Reports, and by its conventions and committee sessions (President, N. Von Buelow).

Professional Organization Required by Law

In Germany the law requires industries employing insurable employees to associate in professional associations. The glass industry is organized in the Professional Association of the Ceramic and Glass Industries which is chiefly concerned with (a) safety and accident prevention, (b) protection against silicosis, (c) rehabilitation, (d) compensation. In the next election a new law will provide 50% participation of employee representatives in the offices of the association.

Individual Fields

Windows—Specialties Aid Double Sales. Window glass is now made in three grades: "thin" (.6-1.8mm), "window" (2-4mm), and "thick" (more than 4mm). "Thick glass" finds an increasing use in store fronts. The great increase of hothouse growing of vegetables has stimulated a great demand for standardized hothouse "windows." In 1951 more than 40,000,000 m² were produced (1950: 36, 1949: 33.4, 1948: 21, 1947: 20).

Plate and Structural—Used as Linings, Too. Unpolished glass has found many new structural uses. Some of those are: protection of espalier fruit gardens, coal shoots, linings of wine, oil and acid concrete containers up to 2 tons.

Building Blocks—Increased 10 Fold. The pre-war production of 500 tons/year was increased to about 5000 t/ year.

Refined Glass (Mirrors, Dials, Bent Glass, etc.)—More than 10% of All. This branch of the West German glass industry has become particularly prosperous and sells about 70,000,000 marks or 12% of the total glass production.

Containers—Double, but Are Only Fraction of U.S.A. Consumption. Far behind the American container glass industry, the German container glass industry nevertheless shows rapid expansion (1936: 330,000 tons (all Germany), 1951: 500,000 tons (70% of population)). Containers represent 48% of the total weight of glass, 84% of all hollow glass produced; in value, 40% of all glass, 58% of all hollow glass. Forty companies make containers, mostly by automatic and (in pharmaceutical and general containers) semi-automatic methods. Germany is interested in following the one-way bottle trend in the U.S.A.

(*Continued on page* 230)

WEST COAST GLASS SESSION HAS UNUSUAL SIGNIFICANCE

The American Chemical Society's Industrial Engineering Division, aided by the spirit of cooperation of many American Ceramic Society Glass Division members, scored in the organization of a three half-day Ceramics and Glass Symposium, by Dr. A. W. Davison, Owens-Corning Fiberglas Corporation, in which glass was the major topic. About fifty people stayed through almost the entire period and participated in the animated presentation, discussion, and reception of unusually significant contributions to glass science and engineering.*

A. F. Prebus and J. W. Michener, of Ohio State University and Owens-Corning Fiberglas Corporation, respectively, presented a paper entitled "An Electron Microscope Study of Glass Structure." The dramatic electron microscope pictures, ably prepared and interpreted, of substructures in fibers and powders made from homogeneous commercial and synthetic glasses, are, indeed, "documents of glass history" (N. Kreidl, discussion remark). They present, in this interpretation, direct evidence for some of the indirect conclusions which we have begun to derive speculatively from strength, radiation, light scattering, annealing, and other data. They suggest that randomness of glass constitution is an integrating assumption that represents the first approximation only to a more detailed picture. Accordingly, glass, at least as it is produced in the normal dynamics of melting and cooling, has often two or more substructures of different degrees of order and, perhaps, composition.

Such substructures appear to become oriented in fibers so that what seem to be chainlike phases several fiber diameters long are observed. This may have something to do with certain peculiarities in the strength behavior of fibers. In simple sodium silicate powder, the substructure resembles hexagonal lumps of several hundred Angstrom diameter. The substructures seem to be affected by heat treatment, but more work is required. They can be developed by acid leaching.

During the lively discussions, possible origins of these structures were discussed, among which were the incomplete wear of grains, e.g., sand, in fusion, and conversely, the greater ordering in the low silica regions of first reaction.

C. L. Babcock, Owens-Illinois Glass Company, presenting a paper with K. Fajans, University of Michigan, and S. W. Barber, also of Owens-Illinois, finds convincing evidence on two types of order even in pure silica, the vitreous classic. Extending the work of Barber and Fajans on boric acid, which introduced the concept of a molecular type of structure in boron glasses at the first glass symposium in Cleveland two years ago, Mr. Babcock went carefully through a great number of properties, adding missing data from an impressive series of new experiments by himself and his laboratory, and showed the existence of at least two types of structure in the simple substance, silica glass. These states cannot be identified with the crystalline modifications of silica as they interchange reversibly and speedily and as some of their manifestations differ greatly from those of crystalline silica. An experiment in which silica glass was caused to have greater (!) expansivity after exposure to high pressure aroused intense interest in the audience.

The Symposium experienced the uncommon adventure of a one-hour lecture received with unabated scientific curiosity. We have never heard statistical theory explained in a more straight-forward way, let alone applied to the intricacies of glass properties. This unusual circumstance was created by the presentation of "Statistical Theories as Applied to the Glassy State" by O. L. Anderson and D. A. Stuart of the Bell Telephone Laboratories and Cornell University, respectively.

Just remember that the probability of something happening is proportional to an exponential in which the variable over a temperature form is the negative exponent. A bond will rupture under force f at a probability exp (—f/kT), and if an external force W is used, fracture, exp (—f+W/kT) diffusion, electroconductivity, internal friction can be treated this way. In each case, there must be subtracted the probability of the broken bond to reform and with rather keen assumption that the two events require half the W, expressions of the form exp $(-f_1+W/2/kT)$—exp $(-f_2—W/2\ kT)$ are obtained. The mathematical trick No. 1 seems to be that such a difference of exponentials is represented by a function that can be looked up in tables, even though it has the forbidding name hyperbolic sine (sinh), and terms of the form

$$2e—f/kT \sinh W/kT$$

are obtained. The trick No. 2 is that this function over wide ranges resembles an exponential and if the frequency of the event (V), the distance (Λ), and the number of particles is introduced, the expressions end up to look like:

$$\Lambda\ n\ V \exp—f/kT\ W/kT.$$

Conductivity, friction, diffusion data for conductivity (Stevels, Maurer, Cox), friction and diffusion (Johnson, Blau, Fitzgerald) are evaluated—only the driving force being different—and very similar activation energies are obtained (around 20).

To the many controversial theories of fracture, Poncelet (1941) first applied statistics, and considered not just flaws, but a chance of flaw generation, using expressions as discussed above.

Other modern workers are Shand, who found a load limit; Guerney, who considered chemical processes on the surface; and N. Taylor, who considered energy instead of force. (*It chanced that at this moment of Anderson's discussion, N. Taylor entered, replete of his late breakfast, and was applauded. He shyly claimed he wished he had gone on eating, but evidently shared the pleasure in this mental exercise.*)

Messrs. Stuart and Anderson stress the surface energy required to form the fractured surface and play with terms W—E/z where E is the surface energy. Everybody, Anderson said, uses the same set of experiments to explain his different theory, and more experiments are badly needed.

In the case of viscosity, theories are all alike and

* These papers will soon appear in full and as one sequence in one of the journals of the American Chemical Society.

don't fit the many experiments. Anderson claims that more theories are required but agreed in the discussion with this reviewer that experiments won't hurt as the chemistry is quite involved.

General laws of the form

$$\eta = A(T) \exp b/kT$$

have been proposed by people such as Seddon, and G. Jones has tried to apply polymer chemistry to the thing. Anderson deservedly credits R. Douglas, whose work also was ably exemplified at the first glass symposium in Cleveland, with a first viscosity theory that fits good data. The peculiar distortion of a vitreous silica network is proven by X-rays that reveal two Si-O distances. Therefore, an atom has two choices of positions of equal energy from which a new picture of vitreous flow are derived. The newer theories suffer from a surplus of constants. Anderson proposes to, for instance, derive some from other data—say, fracture. People in the discussion also proposed to use friction, vibration spectra, and ultrasonics for their purpose.

In summary, Anderson said there is agreement, using statistical theory, on friction, conduction, diffusion; theoretical disagreement and few experiments on fracture; too little theoretical exploration of the many experiments on viscosity.

This reviewer felt, and Anderson agreed, that the evidence on fine structure from other experiments, such as those presented in the Symposium, must be considered in this connection.

N. Kreidl, Bausch & Lomb Optical Company, in his paper "Some Effects of High Energy Radiation on Glass," illustrated, in a sequence of basic slides, the current theoretical and practical work in connection with the reactions of glass with high energy radiation. The glass chemist is drafted to do such work because, as atomic energy installations expand, observation, visual and instrumental, must be through materials specified for absorptivity and stability of transparency; and, as a sideline, glasses particularly sensitive to radiations can be used to detect these radiations quantitatively (dosimetry).

In the theoretical part, it turns out that the rather complicated reactions of glass with various radiations and particles mostly end with fast electrons within the glass causing effects not too dependent upon the primary agent. These effects can be counteracted by cerium, which seems to serve as a trap for the undesirable electron mechanism. Stookey, in the discussion, pointed out important analogies from his experience with uv sensitization of cerium-containing photosensitive glasses. Practical aspects are:

(1) Non-Discoloring Optics. Dr. Kreidl and his associates are now synthesizing optical glasses in which optical properties, initial color, striae, and bubble quality are compromised with the use of enough cerium to preserve transparency after exposures up to 106 roentgons (the current unit of gamma ray dose). Data on some such glasses now available were presented.

(2) Absorbers. Absorbing glasses were not discussed in detail, except for reference to the Silverman, Sun, Rothermel X-ray absorbing lead-tungsten-phosphate glass, and the specific absorption of neutrons by cadmium borate.

(3) Dosimeters. Detection of radiation by glass is in the practical stage and complete instruments were shown that are based on engineering work of the author, on the discovery by J. Schulmann and associates at the Naval Research Laboratory, of a silver phosphate glass which detects proportionally wide intensity and energy ranges of gamma rays. In research, the trend is toward detection by visible color, if necessary by crystalline materials embedded in amorphous ones (J. Schulmann), in which fields the present author has not reached decisive results.

The wealth of information on photosensitive glasses that was reviewed by their discoverer, S. D. Stookey, convinced this reviewer to report his paper, "Recent Developments in Photosensitive Glasses," among the "practical" papers. The original photosensitive glass, in which metals are sensitized by uv, and developed into beautiful colors reaching into the glass where the negative was transparent, now yields exquisite art. It is followed by photosensitive glasses in which phase separation is nucleated and permits "machining" of fine and intricate lace patterns.* This has been reported elsewhere.

Stookey fascinated the audience by another cousin of this family in which heat development turns the sensitized glass in a material of great strength (20,000 psi. polished: 30,000 psi.). We doubt that anybody would be able to tell, on inspection, what this material is, or to call it something if he knew what it was. We managed, with the physical strength sometimes given chemists, to break a piece after the show, but we are inclined to brag about it.

Photoengraving processes, too, are developed as part of the photosensitivity program. Stookey also taught how to make a positive from an ordinary glass ("fotostain"). It is contacted with the silver image of an emulsion, painted with a clay ferric sulfate paste, heated at 450-500°C., then reduced with H or N.

In the quite excellent summary by Robert L. Shute and Burnham W. King, Battelle Memorial Institute, of what could be called the State of this Glassmaking Art, Mr. Shute impressed this reviewer mostly by his emphasis on briquetting. It is true that he said only three or four plants do it, but he seemed to imply that it was mostly because of direct cost. He seems to believe that briquetting would allow the use of much less highly specified materials and promote better furnace runs. He recommends more investigation.

Shute started out by comparing glass furnace operations to navigation and stressed that we are now "doing it" by instrument flying. Temperatures, even in the metal, pressure, levels are automatically controlled; levels are now sometimes watercooled.

Some interesting figures: plate glass rates are now from 80-90″ to 200-300″/min. $2-6,000,000 rather than perhaps $30,000 are needed to invest in a small plant. U.S. consumes 69 containers per man year, England 5, Germany 1.2, others, less. Electric melting, emphasized in Europe, finds some application. An unenclosed glass furnace in Indiana is a cool sensation. Glass sizes range from 2-3 micron fibers to 7000 lb. windows. Stirring may emerge from the exclusivity of optional glass plants.

The incredible spectrum of glass uses was brilliantly demonstrated by A. Silverman in his paper, "What's New in Glass."

* 1/1000″ holes!

A very specific, but wide-spread use of glass, is in air conditioning and other dust and smoke filters. J. W. Michener read the paper "Glass Fibers as Filtration Media" by Clayton A. Smucker and W. C. Marlow, Jr., in absentia. Filters can be prepared from fibers 1/4-250 microns thick. Bonded, such materials show strength to 200,000 psi. Air conditioning usually applies the 150 size. Testing procedures that were demonstrated decide definite uses as dust and smoke problems have different aspects. So far, two or more step installations suggest themselves.

Audience reaction singled out 1/2 micron fiber paper and a more economical picture was indicated for the future of such paper by the lecturer.

E. B. Shand's (Corning Glass Works) paper, "Evolution and Present Application of Industrial Glass Piping," presented by a colleague, illustrated in word and picture the impressive progress of glass piping as an engineering material in aggressive competition with metals. Questioning clarified that glass piping fits standard equipment. Outdoor installations of considerable size were shown in the many slides.

A. K. Lyle's (Hartford-Empire Company) discussion of viscosity, "Correlation of Viscosity Data and Working Characteristics of Commercial Glass," was the subject of various bull sessions on the West Coast on the days following the meeting; this among the practical men employed by the younger independent companies that grow there, and we heard that some of Lyle's ideas will be applied in their control work.

The viscosity behavior of various glasses was subjected to detailed comparison, but the suggestion was made that the measurements of two viscosity points may often suffice.

If, for instance, S is the Littleton-Lillie softening point and $\triangle$ the annealing point, one may use the feeding temperature $G=3.7\ (S-A)+A$

the devitrification number (the larger the better, out when negative)	$D=(S-A)-170$
the working range	$W=(S-A)$
the machine speed	$M=S-45/((S-A)+70)$

(We hope we have it right!)

David D. Billings and Eleanor M. Brown, Glass Containers, Inc., ("Use of Spectrophotometer in Glass Control Work") gave us an example of the growing awareness regarding control methods in the younger West and showed very attractive color control data. In particular, they showed spectrophotometric curves of off-shade bottles that correlated with customer judgment. They also discussed flame photometry and colorimetry in analytical control.

Victor C. Swicker, Alexander H. Kerr & Co., Inc., ("Problems of the Glass Container Industry on the West Coast") brought to light surprising peculiarities of the Western glass industry. Consider, for instance, that some container people have to live with a sand like this: SiO_2 81.0, Al_2O_3 11.7, Fe_2O_3 0.075, CaO MgO 1.5, Na_2O K_2O. 5.5 Ign. Loss 0.2. They had to develop, and work with, higher Al_2O_3 glass than that incorporating feldspar in the East (9% Al_2O_3, 64% SiO_2!).

For soda ash, they had to take low priorities from the East, but will start to make their own in Green River, Wyoming, this spring.

The favorable situation in electrical power has encouraged the operation of the first U.S. electrical container furnace in Seattle. Research is concentrated in the East. Half of the Western plants, however, have now no Eastern ties and, therefore, have developed an unusual comradeship. In the remainder of his stimulating address, Swicker summarized container glass problems shared by East and West.

Other papers given of allied interest included one by Louis Navias, of General Electric Company, entitled "Advances in Ceramics Related to Electronic Tube Developments"; "Recent Developments in Refractory Materials for Gas Combustion Equipment" by Emil Blaha, The Selas Corporation of America.

Last, but not least, mention should be made of the inaugural speech made by A. W. Davison, of Owens-Corning Fiberglas Corporation. In his opening remarks, Mr. Davison climatized the session introducing the fiction of a twenty-year rhythm of scientific progress in which he worked out the sequence of a communications (1900-1920), chemistry (1920-1940), and a special materials period (1940-1960). Electrical and optical requirements are among the driving forces. His welcome included mention of the climate of Southern California which, upon such appeal, conformed to 60-70°C. through the week of the chemical conclave.

N. Kreidl, speaking, he hoped, for a qualified majority, expressed the sincere interest of the Glass Division of the American Ceramic Society in, as well as appreciation of, this forum on glass science and practice, and any other anywhere.

BROCKWAY TO OPEN NEW OFFICE BUILDING

The Brockway Glass Company has announced that work has already been started on the former Brockway Box Company building which the local glass firm is renovating as a modern office building.

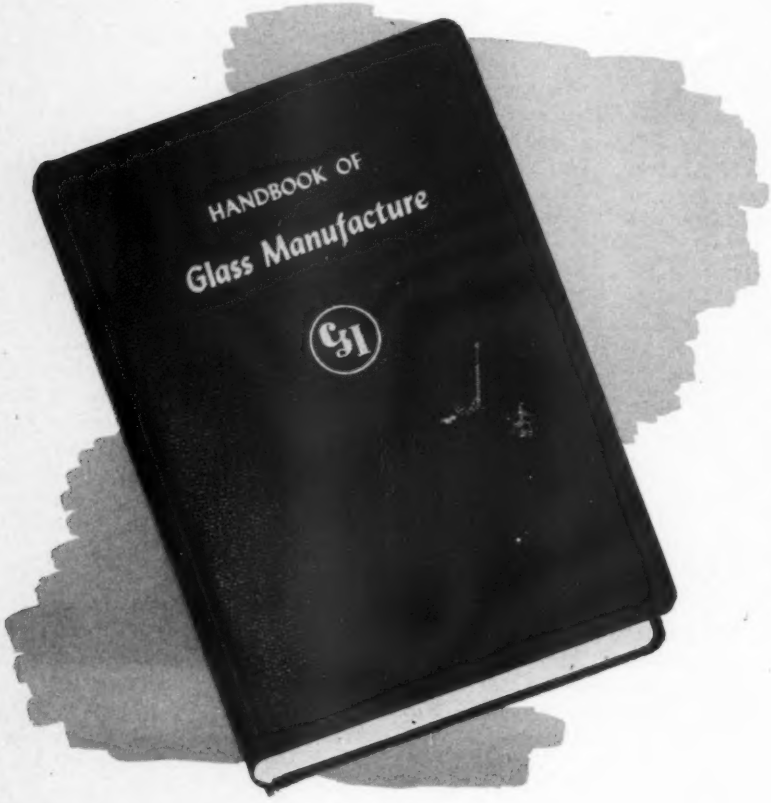
The new building will contain 62 offices and will house all the departments which are at present divided between two buildings and several departments which are now located in the plants. Plans call for a one-story building with liberal use of glass for decorative and functional purpose. Glass block and fiber glass for acoustical soundproofing will be used throughout.

NEW GLASS FIBER PACKAGE CUSHIONING

A new glass fiber resilient board material, called "Vibraglass," is coming into use as an aid for safe packaging of delicate equipment. Originally designed as a shock cushion and thermal expansion material for solid propellants in various rocket-powered missiles, "Vibraglass" has many advantages as a cushioning material. It is incombustible, fungus and vermin proof, lightweight, chemically neutral, easily fabricated, insoluble in water and common solvents and has long endurance life with no permanent set. Properties remain constant from —65°F. to ±165°F.

A new tool for

Glass Plant Executives • Research Heads • Laboratory Technicians • Engineers • Technologists



The Handbook of Glass Manufacture is the only book of its kind, and for all who are engaged in glass manufacture and those who serve the industry — it is as necessary as sand in the batch.

Twelve years ago, the Ogden Publishing Company, publishers of The Glass Industry, produced the first handbook ever to be published for the glass manufacturing industry. This book was widely received but so much has taken place in the intervening years in technological and engineering development and in operating techniques that there has been an ever increasing demand by glassmen for a modern and more comprehensive working manual.

After more than three years of planning, preparation, compiling and editing, we now offer to the glass manufacturing industry the *new* HANDBOOK OF GLASS MANUFACTURE.

THE NEW HANDBOOK OF GLASS MANUFACTURE is comprised of more than 500 pages of practical reference data—tables, charts, formulae, illustrations, and text—on all phases of glass manufacture. Each section has its own table of contents, in addition to the master table. A comprehensive index provides quick reference to the contents of the entire book.

Basically, the HANDBOOK OF GLASS MANUFACTURE is intended to give those engaged in glass manufacturing operations a starting point, or point of orientation, with respect to particular problems confronting them. By becoming familiar with materials, apparatus, equipment, and principles relating to a given problem, and with points of view that have proven successful on similar problems in the past, this new Handbook should enable those who use it to get off to a better start in solving a given problem.

It is a primary working tool for plant executives, research heads, laboratory technicians, and engineers. It is complete enough to be used as a text or reference work for a course in glass technology. It can also be used effectively by glass companies as a source of reference to many of their customers and others who wish to obtain a general knowledge of glass manufacturing.

• • •

This new handbook is the product of many individuals, each one particularly qualified to handle the subject assigned to him—a truly collaborative effort. Those who have made this book possible and their subjects appear in the opposite column.

FAY V. TOOLEY, *Editor-in-Chief*

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Aaron K. Lyle, *Hartford-Empire Company, Div. of Emhart Mfg. Company*

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Donald E. Sharp and A. E. Badger, *Libbey-Owens-Ford Glass Company*

Raw Materials
Samuel R. Scholes, *New York State College of Ceramics, Alfred University*

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ELECTRICAL GLASS MELTING

By DIPL-ING. I. HOROWITZ

Olten, Switzerland

TRANSLATED BY DR. S. R. SCHOLES

PART III

New Designs of Electric Tanks

Three-cornered Tanks. A departure from classical design in electrical glass melting furnaces has also been introduced, which can best be named "three-cornered furnace."

The first of these was probably installed by Grebertschnikoff in Goi (U.S.S.R.). J. Finger[37] has built a series of such three-cornered tanks in Spain, since 1938. The first one installed was used for water glass production. In later furnaces, a working chamber was added at one corner, connected to the melting chamber by a deep throat. These furnaces were electrically arranged in such a way that two phases of the polyphase current were connected in the melter, while the third phase entered the working chamber. Of the data on construction and operation of the Finger furnaces in Table II, Nos. 4 and 7 refer to three-cornered tanks. The low energy consumption per kg. of glass, especially since it was achieved with small units and low voltage, is surprising. Wartime difficulties in selecting raw materials compelled the use of amorphous carbon in making electrodes. Nevertheless, in all cases it was possible to make glass of good quality.

Table II

Construction and Operating Data for Finger's Tanks

No.	Glass Variety	Tank Surface in m² for: Melting	Fining	Working	Power, Kw	Connection, Phases	Pull T/24 Hr.	E.M.F.	Energy, Kw.Hr./Kg.
3	Lamp Bulb	1,00	1,00	0,5	100	1 Phase	2	220	1,4
4	Window (Excl. Ref.)	5,00	—	—	250	3 Phases	5	220	0,9
6	Apparatus Glass, Tubing	4,00	—	—	260	1 Phase	3,5	350	1,2
7	Soda Waterglass	3,5	—	—	200	3 Phases	4	200	0,9
9	Lead, for Tubing	1,40	—	0,1	80	1 Phase	0,5	220	1,1
11	Flint Bottles	2,0	2,0	2,0	270	1 Phase	3,5	280	1,2
11A	Flint Bottles	3,8	—	0,7	270	1 Phase	4,0	280	1,0
18	Lead, for Tubing	4,0	—	—	260	1 Phase	4,8	280	1,0
19	Amber Bottles	1,4	—	0,65	115	1 Phase	1,0	220	1,6
21	Borosilicate	1,3	—	0,65	180	2 Phases	0,8	380	2,5

Several three-cornered electric tanks operated under the "Electroverre Romont" system have been built in Italy during recent years (Fig. 17).

For melting glass for lamp bulbs, a Swiss glass factory has two furnaces on the E-R type. Originally, the furnaces were equipped with round, cylindrical graphite electrodes, which were arranged across the tank in the usual horizontal direction (almost to the opposite sidewall, but not clear through). However, the furnaces were dismantled after a time and rebuilt with vertical electrodes rising through the bottom. The vertical arrangement promoted convection, with its usual benefits (cf. Fig. 6). Danger of overheating the glass near the electrodes was also thus reduced. Better circulation, improved decolorizing, and more uniform conductivity of the glass between electrodes were favorable aspects.

The only disadvantage of this increased circulation is that glass of different stages of melting may be mixed, and the clear glass may be carried into a region of bubbly glass, or even that unmelted materials may be carried into the clear glass. To hinder safely the extreme convection currents from passing from one zone to another, the three-cornered tank seems more suitable than the usual form. Melting, fining, standing-off, and working areas are separated, except for submerged throats. Similar solutions for other relationships have been proposed, which will be discussed further in what follows. However, nothing is yet known of any efforts to make purely electrical installations with three independent tanks for the three stages of melting and working.

The Development of the "Cornelius" System. Similar considerations form the basis for further development of the Cornelius system of electrical glass melting tanks. Here, also, the melting installation is divided into three parts. Cornelius, of course, did not propose separate tanks for the three stages: melting, fining, and working.

Fig. 18 shows how the furnace was successfully built as a unit, albeit each of the three stages was separated from the next by a deep throat. According to a report by Y. R. Cornelius,[37] such a melting tank has been operated with the best results in the plant of Northwestern Glass Company, Seattle, Washington, since 1945. Amber bottle glass meeting all requirements of quality is produced. The pull reaches 25 tons per day, with power at 750 Kw. The installation was revised in 1946 to require 1500 Kw. Energy requirement is reported extraordinarily low, at only 0.95 Kw. hr. per Kg. of glass as an average of several months of operation.

As in the installation by Cornelius at the American Cyanamid Company, already described (where water glass

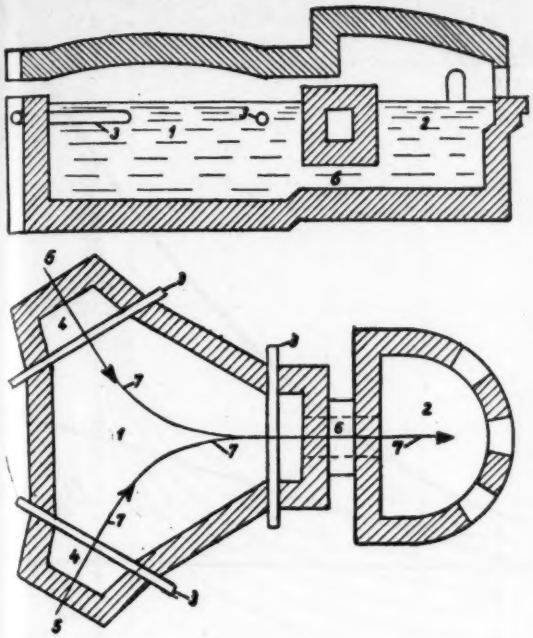

Fig. 17. Three-cornered tank, Electroverre Romont System.

was melted), the melter of this tank has no crown. The glass is continuously covered with batch, which serves as insulation. Graphite electrodes are used. Cornelius has apparently given up the iron electrodes formerly employed. Loss of electrode material in this tank is about 14 to 15 grams per ton of glass.

The arrangement of the electrodes, in particular their distribution to the different zones of the furnace, is shown in Fig. 18. Power is supplied through three transformers of 500 K.v.a. each. Two of these transformers deliver to the melting zone, and the third takes care of the fining chamber. Each of the transformers is single-phase, and carries taps on the high-tension side for stepwise control of the voltage. In this manner, good regulation of current is made possible, for melting as well as fining. By the separation of the three transformers, there is at the same time equalization of load on the high-tension system, since each transformer is connected to a separate phase of the system.

A report from A. E. Cornelius indicates that further installations of the Cornelius system have been in operation in Sweden, also in Finland and Norway, for several years.

It should be noted at this point that the above-mentioned report by Y. R. Cornelius, in connection with different electric tanks in the U.S.A., discussed the use of molybdenum electrodes. Molybdenum has a very high melting point (2550°C.), and has the further advantage that its oxide does not color glass. High cost prevents its use, except in melting some special glasses.

Y. R. Cornelius also mentions the possibility of an auxiliary oil fire in the fining chamber for intense heating of the surface. Such an arrangement is properly discussed in the following section.

Furnaces Combining Electrical and Fuel Heating

The War caused fuel shortages in many countries, also in Switzerland, where electrical energy was short during the winter months. The shrinkage of supply of electricity could not be predicted because it depended upon water supply for the power plants. With foresight as to the possibility of avoiding these stoppages arose the plan of using a combination of electrical and fuel heating. The Swiss glasshouses concerned made bottles of various kinds and wide-mouth glasses of ordinary green glass. The large glass tanks fired with producer gas were supplied with auxiliary electrical installations, in order to economize on fuel as much as possible during the summer months. On the other hand, gas alone was used in the winter, when the electricity failed.

In proportioning electrical heating, the primary consideration is that fuel-firing must cover the external losses of the tank, while electrical heating takes care of the ac-

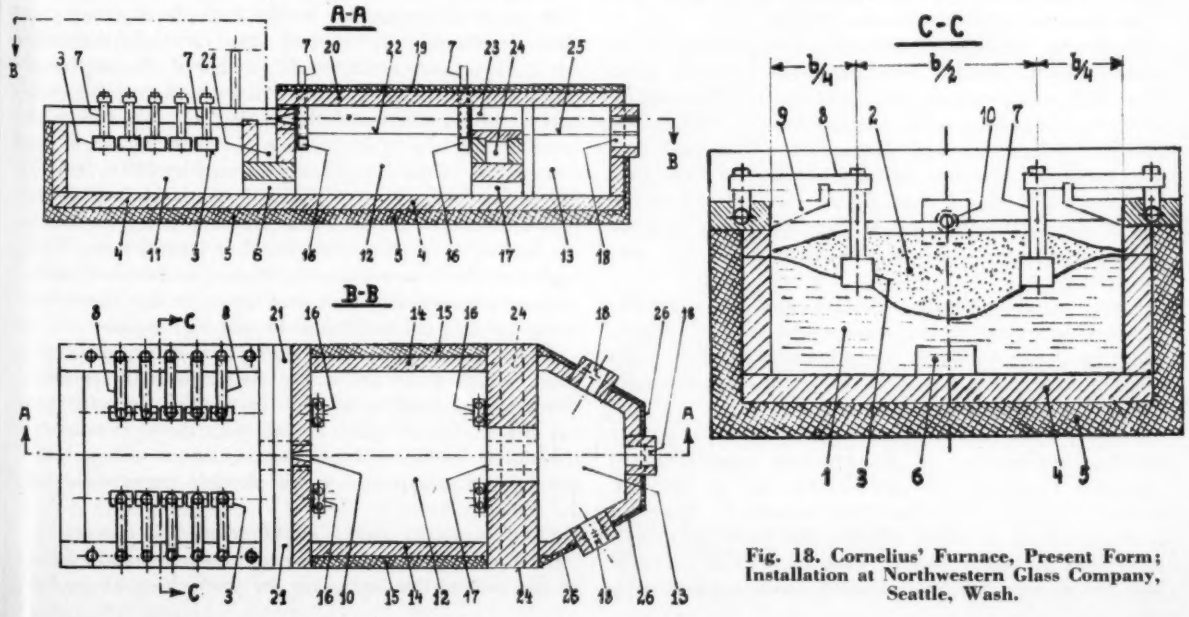

Fig. 18. Cornelius' Furnace, Present Form; Installation at Northwestern Glass Company, Seattle, Wash.

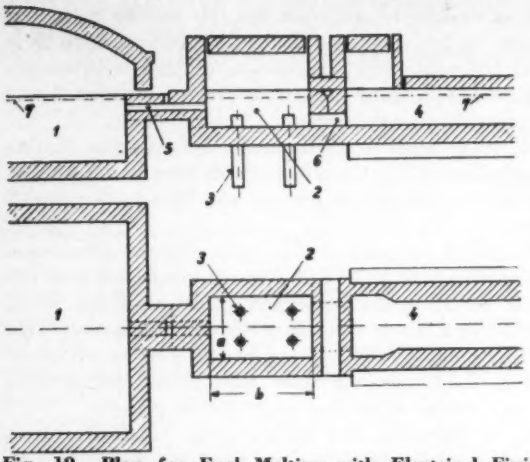

Fig. 19. Plan for Fuel Melting with Electrical Fining. "Cell System" of St. Gobain (after Borel).

tual melting. The melting and fining tank swept by a horseshoe-shaped flame is 7.6 m. long and 6.4 m. wide, inside. On each of the two longer sides are six horizontal electrodes dipping 1.2 m. into the glass. Each side of the furnace has a regulating transformer and switches, whereby the voltage, over a considerable range and for each pair of electrodes, can be regulated. Also, the possibility of various connections of electrodes permits safe control of the heating of the melting tank.

The working chamber is connected to the melter by a deep throat and is heated by one pair of electrodes. Two Roirant single machines operate directly out of the tank. On the right and left of these, symmetrically to the axis of the furnace, are placed two Lynch bottle-blowing machines fed by Hartford-Fairmount feeders. The heating necessary to maintain uniform glass temperatures in the channels of the feeders is accomplished by the use of silicon carbide resistors, which have proven effective. The efficiency of this installation was quite satisfactory. With a pull of 38 tons per day, the energy required was 0.6 to 0.65 Kw. hr. per Kg. of glass. At the same time, producer gas supplied 2000 Kilo-Cal. per Kg. of glass. The total electrical power needed was 1000 Kw.

Successful operation resulted in similar heating operations elsewhere. Borel[38] describes a tank for green glass, fired with producer gas, which was connected for auxiliary electrical heating of the melting chamber. It was thus possible to increase output from 20 to 30 tons per day. The connected load was 350 Kw., at 3 x 45 volts, thus expending 0.28 Kw. hr. per Kg. of glass figured on the entire pull, or 0.84 Kw. hr. per Kg. figured on only the 10-ton increase. Details are lacking as to the fuel consumption.

Tanks with combination heating show different efficiencies according to the management of the furnace, since fuel-firing facilitates operation and control of the melting process, whereas electrical operation makes more demand upon the melting personnel.

Success with such melting tanks gave occasion for serious consideration of the practical possibilities of combined electrical and gas heating, and to the best utilization of the advantages thus presented. These led to constructions in which refining was made quite separate from the usual melting procedure. The new-style layouts consisted of three tanks in series, connected by

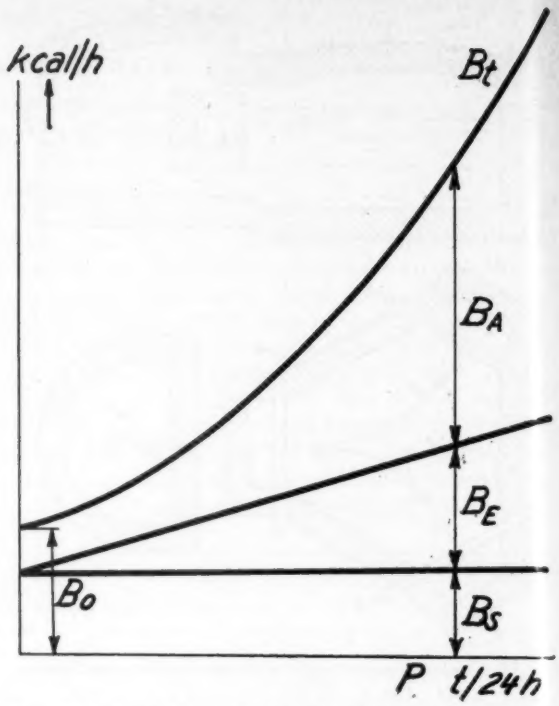

Fig. 20. Load Law of the Tank Furnace. Function $B = f(P) = B_o + \alpha P + \beta P^2$ for oil-fired tank furnaces. Development of the curve B_t: B_A = Flue-gas loss, B_E = Heat of fusion of the glass, B_S = Radiation losses, etc., B_t = Total load requirement of the furnance, B_o = Losses at no load (empty or idle), P= Yield of the furnace in Tons/24 hr. of glass, α, β = Constants.

throats: the first served only to melt the batch, and could be called, in departure from previous designation, the pre-melting tank; the second was the fining chamber; the third tank served in the customary way as a working chamber. In these generally similar divisions of the melting process, two fundamentally different solutions of the problem appear:

(1) Electrical Pre-melting, with Gas-fired Fining Tank. The electrodes immersed in the bath develop heat by direct resistance in the melting mass, especially desirable for melting down the batch. The unmelted, floating batch forms an effectively insulating layer, concentrating the heat in the glass bath and eliminating very largely loss of heat through the crown—indeed in large measure, the temperature of the crown being lowered by 450 to 500°C. The intense concentration of heat in the batch itself made possible a rate of pull of 4 tons per m.² per day (two-and-one-half sq. ft. per ton!) of glass free from defects. This high yield made possible small dimensions for such tanks, with correspondingly small heat losses, so that these furnaces use only 0.7 to 0.8 Kw. hr. per Kg. of glass.

The particular goal of the fining period is to drive out gases, which make up several times the glass volume. Temperatures must be as high as possible, especially at the surface, for the gases contained in the glass must be released as bubbles which collect and escape. Flame heating seems thus best to meet the physical requirements of the fining process.

(2) Pre-melting Tanks, Fuel-fired with Electrical Fining. The energy for the fining process amounts to 10 to 15 per cent of that necessary for pre-melting alone, but

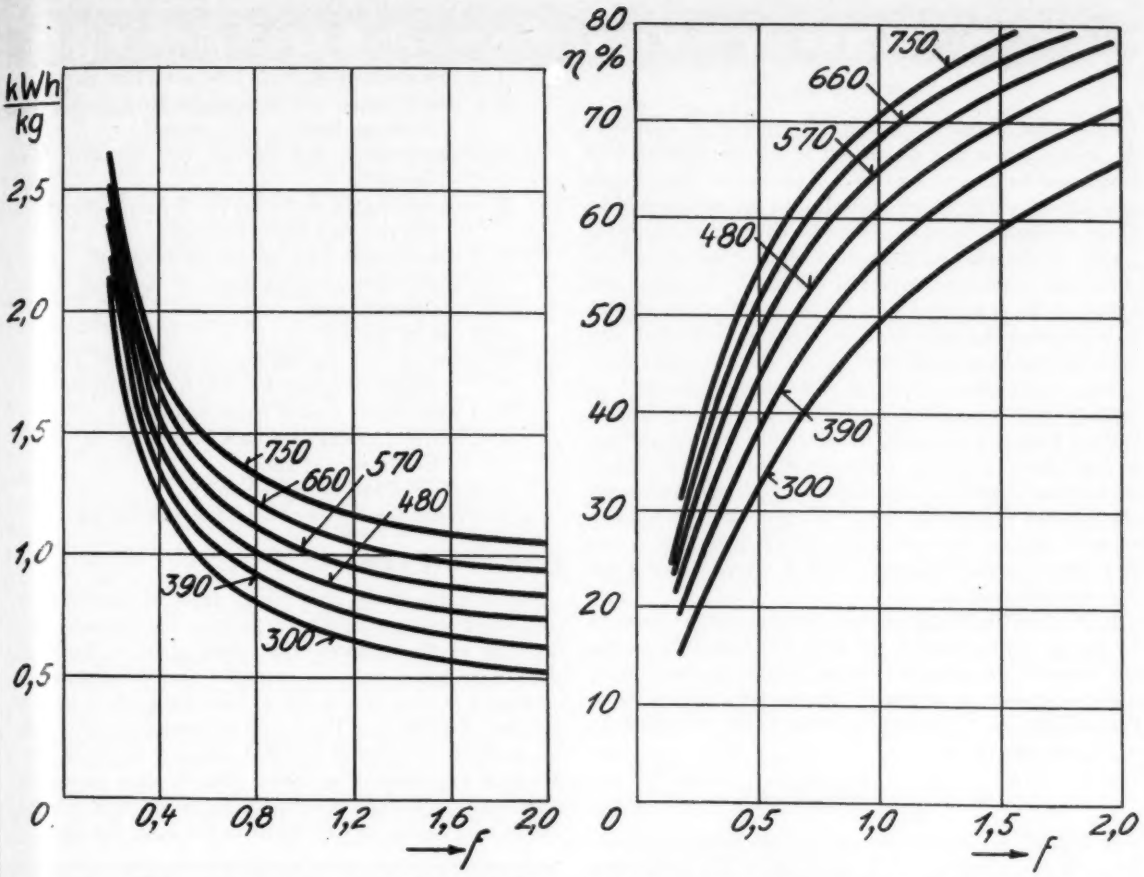

Fig. 21. Specific Energy Requirement and Efficiency of Electric Tanks with Direct-Resistance Heating as a Function of Yield Factor f (Number on curves refer to heats of fusion of glasses).

including heating the batch to the necessary melting temperature. The high temperature for fining needs a relatively large amount of fuel for the required net quantity of heat. On the contrary, the expenditure of energy in direct-resistance electrical heating is independent of the temperature at which a certain quantity of heat is generated in the glass bath. Homogenizing during fining is promoted by the strong convection currents set up at the electrodes. This is particularly true with vertical electrodes, as in Fig 6. Direct-resistance heating in the fining tank makes possible unusually high rates of production up to 15 to 20 tons per m.^{2} per day (about 0.6 sq. ft. per daily ton!), and thus a yield-factor of about 12! The small dimensions required give the name "Electro-fining Cell" (refining cell) to this intermediate chamber.

The St. Gobain Glass Mfg. Company has built a number of such installations with fuel-fired pre-melters and electrical fining cells, the essential features of which are shown in Fig. 19. Borel gives data on such a cell: length, 1.7 m., width, 1.0 m., and depth 0.6 m.; the output, 24 to 28 tons per day; power, 160 Kw. The fining yield is 16 to 16.5 T/m^2 per day, with a yield factor to 10 to 11. Other reports describe an electrical fining cell of 32 ft.^{2} area, clearing about 84 T/day and using about 0.11 Kw. hr./Kg. fined glass.

In general, these cells require 0.15 to 0.25 Kw. hr./Kg. In this connection it is important that the movement of convection currents between fining cell and melter is hindered; otherwise, considerable loss of heat and energy results. Essentially, the flow of glass in the throat connecting melter and finer is transferred near the surface. However, no definite conclusion can be reached from that fact because the reverse current of already fined glass into the cooler melting chamber cannot be entirely stopped. In later installations, therefore, submerged throats were built between melter and fining cell.

The partition of the melting process into pre-melting and fining, done in separate tanks, is an essentially progressive step and a contribution to glass technology which cannot help influencing the construction of tanks to be heated only by fuel. A completely electrical installation of this kind, on the basis of the results quoted earlier, would need 0.7 to 0.8 Kw. hr./Kg. in the pre-melter, and 0.15 to 0.25 Kw. hr./Kg. in the refiner, making a total of 0.85 to 1.05 Kw. hr./Kg. of finished glass.

The question, which of the two types of tanks using combination heating, as described, serves better in a given case or whether electricity is preferable for both melting and fining, rests in the first place on the comparative prices of fuel and electrical energy. It can be answered only on the basis of complete estimate of efficiency.

Energy Requirement of the Electric Tank Furnace

From the general load law of the tank furnace,[39] shown

in Fig. 20, there is derived for the electrical tank furnace where there is no flue-gas (so that $\beta = 0$) the equation:

$$B_t = B_o + x.p$$

In fuel-fired furnaces, the melting load P is related to the melting area and designated as specific melting load (expressed in tons or Kg. per m.^{2} per day). This magnitude is not suited for comparison with the tank heated by direct resistance because here are concerend not only the surface of the glass in absorption of heat, but also all the electrically conducting layers of the glass. Therefore, the notion of the production-factor f comes into play. By this is understood the ratio between the weight of glass produced in one day to the total weight of glass under heat.

For comparison, it must be particularly noted that, in English and American sources, the figures on specific melting load are reckoned on the single melting surface. In both these countries, in the conventional construction, the melting chamber connected by throat with the working chamber is spatially completely separate. In German reports, data on the total glass surface often appear. In these latter cases, the melting area is taken as two-thirds the total glass surface.

It may now be simply derived that the relation between the energy requirement A_e per Kg. of molten glass, as also that between the furnace efficiency η and the production factor f, may be represented by an equilateral hyperbola. Particularly, the following equation holds, in which C_1 and C_2 are constants:

$$A_e = \frac{C_1}{f} + C_2.\text{Kw.hr./Kg.}$$

In Fig. 21 are plotted the calculated energy consumption and the efficiency as a function of the production factor for electric tanks with direct-resistance heating.

Melting Costs

The question of the practical introduction of electric tanks in glass manufacture is essentially one of earning power which must be proven for each single case in comparison with other types of furnace. The cost price per unit of product is the only basis for comparing profitability. Here, the unit is the weight of finished glass of good quality. Melting costs include not only the cost of heat, but also of furnace tending, amortization, interest, and maintenance and repair of the furnace. Here belong also wages and costs for ware made of defective glass, useless except as cullet for remelting.

The following equation is valid for every glass melting furnace, for working costs:

$$S = \frac{10{,}000}{i.q} \cdot \frac{A + B + (J.C) + D + E}{1000.J.t};$$

in which:

$$A = a.r.1000.J.t. \frac{i}{100}$$

$$C = \frac{C + Z}{100} \cdot V$$

$$D = \frac{V.J.d}{100}$$

The symbols mean:

S = Melting costs in monetary units per Kg. of glass
q = per cent ware free from melting defects
i = furnace efficiency in per cent
A = money cost of fuel or energy or both
t = days per year of furnace operation
J = furnace load (pull) in tons per 24-hr. day
B = yearly outlay per furnace for tending, superintendence, loading, etc. (money)
C = amortization and interest, per ton daily load (money)
E = outlay, wages, and costs for defective glassware, per year and furnace (money)
V = Construction costs per ton of daily pull
c = annual amortization quota in per cent of construction cost
z = rate of interest
D = annual cost for maintenance, repairs, etc., exclusive of outlay for fuel for hot repair
d = ditto, in per cent of construction cost
a = energy consumption, in Kilo-cal./Kg. or Kw.hr./Kg. of glass
r = price of fuel or energy unit
e, g, h = index for electrical heat, gas, heating oil

Comparative Values

Construction costs, as well as rates of amortization, etc., differ widely according to the size, the character, and the style of the furnace. The values given in Table III should be taken only as examples for installations of medium size, that is, capable of producing 10 to 15 tons per day of 24 hours. The length of campaign may safely be assumed as equal at t = 250 working days per year, although experience has shown that, in this particular, the electric tanks are superior to those otherwise heated. Values of i and q may be taken as the same for all.

Table III

	V	C,%	d,%
Gas-fired Regenerative Tank, Complete, except Chimney and Gas Producer	X	20-25	10
Oil-fired Recuperative Tank, Complete	0.85.X	25	10
Electric Tank, excluding electrical connections and electrode wear	0.5.X	25	10-20

The operating costs B can also be taken as equal for all kinds of furnaces, and left out of consideration in a comparative reckoning. This is permissible, however, only if, neglecting the cost of generating producer gas, the price per unit of fuel delivered to the furnace is introduced. The price of producer gas depends on the price and the heating value of the coal used, the amount and kind of ash, the efficiency and installation-cost of the producer, its amortization, the load factor, and wages. The distance from producer to furnace affects the heating value of the gas and its price at the furnace.

In glass factories, the efficiency of well-operated producers can be taken at 75 to 80 per cent. Most simply, the cost of 10^6 Kilo-cal. of heat will be ascertained from the calorific value of the coal and the producer efficiency, while the entire cost of gasification is proportioned to the ton of gasified coal and reckoned on the cost of coal delivered to the producer. (*Continued on page* 226)

Inventions and Inventors

Feeding and Forming

Improved Blowhead Structure. Fig. 1. Patent No. 2,627,702. Filed March 25, 1950. Issued February 10, 1953. Two sheets of drawings. Earl L. Lowe.

In the above invention, strain and check marks are avoided in the bottle finish by causing air to move and swirl around the bottle finishes in such a manner as to distribute air circulation in a more even manner than is accomplished by nozzles of conventional blowheads.

As indicated in Fig. 1, nozzle 10 has a center passage 17 bored of a relatively larger diameter than passage 18 which continues through nozzle 10 to the outer end of head portion 15. The central passage 17 includes an underbored portion within head 15 forming a connecting well 17', or undercut portion, for passages 17, 18 and radiating exit passages 19. Passages 19 are adapted to direct a portion of cooling air stream 21 from within bottle 10 to the exterior of the same near the bottle finish area 22. By reason of the angular position of passage 19, that portion of airstream 21 emerges in swirling path around finish 24. Airstream 20 directed vertically into bottle 25 is reflected back by a concave lower face 26 of the nozzle 10, thus providing complete distribution of air around finish 24.

The patent contains five claims and the references cited were as follows: 1,783,201, Soubier, Dec. 2, 1930; 1,940,615, Webster, Dec. 19, 1933; 2,198,750, Winder, Apr. 30, 1940; 2,290,798, Berthold, July 21, 1942; and 2,347,181, Cox, Apr. 25, 1944.

Drawing Sheet Glass. Fig. 2. Patent No. 2,628,453. Filed May 5, 1948. Issued February 17, 1953. Two sheets of drawings. Assigned to Pilkington Brothers Ltd. by George Telford Pye and Harold Goulbourne Jones.

Apparatus for removing and detaching a sheet of glass from an upward traveling ribbon of glass is shown in Fig. 2.

Suckers 5 are connected with a flexible line 11 and are connected through a pressure operated switch 12 to a vacuum line 13. The suckers are mounted on carriage 3 and their movements are under the control of the leading edge of glass. By means of the pressure-operated switch 12, the suckers 5 are permitted to remove the glass above the score line.

The suckers may engage the glass immediately after the formation of the score line or during the formation of the score line, or immediately before the formation of the score line.

By the present invention, expeditious manipulation of the hot cut-off sheet of glass is attainable, and by reason of the manner of removing the glass from the path of rising ribbon, shelling of both the trailing edge of the severed sheet and the leading edge of the rising sheet is eliminated as the carriage arrives at the position in its return journey to operate the trip cock and cut-off suction. The suckers may become disposed over a trackway on which runs a dumping table 2a so that the glass is received and rapidly removed.

The glass may also be removed by hand from the suckers when the partial vacuum is destroyed, and fans (not shown) may be disposed at the side of the path of the movement of the glass when held by the suckers so as to cool the glass before it is so handled.

The patent contains eight claims and the references cited were: 1,741,026, Koupal et al., Dec. 24, 1929; 1,905,748, Redshaw, Apr. 25, 1933; 1,922,327, Redshaw, Aug. 15, 1933; 1,931,700, Murphy et al., Oct. 24, 1933; and 881,834, France, May 10, 1943.

Feeding Glass Ribbon. Fig. 3. Patent No. 2,623,335. Filed March 29, 1950. Issued December 30, 1952. Two sheets of drawings. Assigned to Pilkington Brothers Ltd. by Pierre Bousseau and Robert Touvay.

An ingenuous method is presented to permit the regulation of the pressure in accordance with the thickness of the ribbon of glass as it moves between two rolls. Such pressure should be proportionately less as the ribbon being treated is thinner, i.e., more fragile.

In Fig. 3 the end of the shaft 3 of the roller 2 rotates in a bearing not shown in the drawing, which bearing is

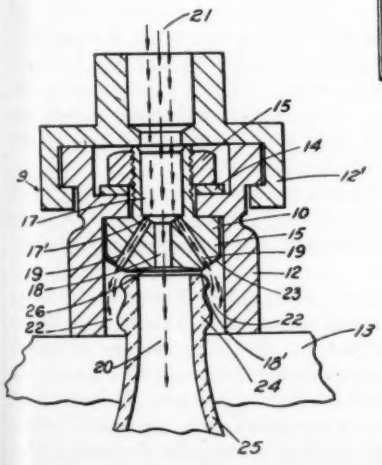

Fig. 1.

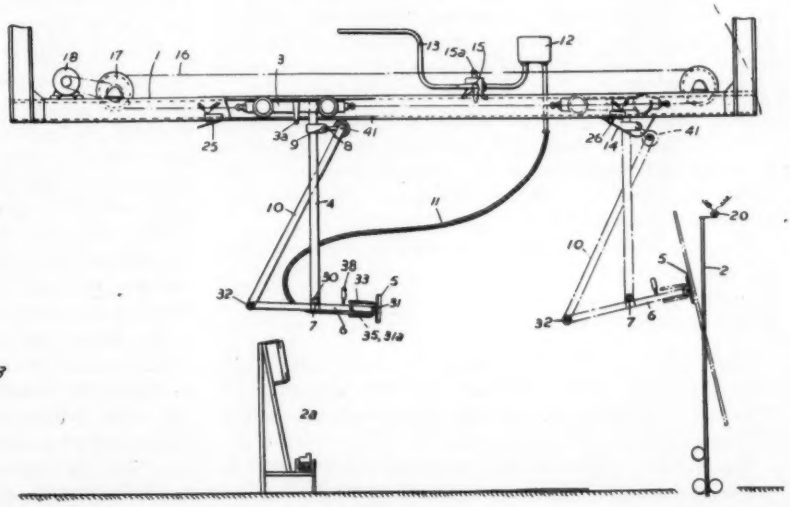

Fig. 2.

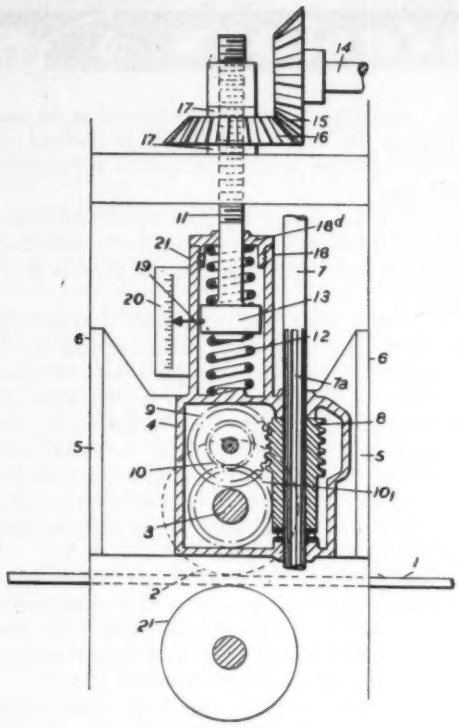

Fig. 3.

integral with a housing 4. It is on this housing that the pressure is exerted. The housing is movable vertically in such a way as to permit the roller 2 to bear on the ribbon of glass, irrespective of the thickness of the latter. For this purpose it is furnished with shoes 5, which slide along two guideways, the guide faces of which are designated 6. The rotary movement of the roller 2 is obtained in the following manner:

The vertical shaft 7 of an endless screw 8 has a rotary movement imparted thereto by a motor not shown. The endless screw 8 engages with a toothed wheel 9 which, by means of a gear train 10, 10_1, transmits its rotary movement to the shaft 3 of the roller 2.

In order to permit of vertical displacement of the housing 4 in accordance with the thickness of the ribbon of glass, the driving shaft 7 possesses longitudinal grooves 7a, which engage in corresponding grooves in the hub of the endless screw 8. The lower roller 2' can be loose on its shaft, or it can also be mechanically actuated by a similar gear system engaged by the same shaft 7.

The pressure is obtained by a vertical force applied to a rod 11 and transmitted to the pressure element by way of the housing 4 through the medium of a resilient connection constituted by the springs 12 and 21.

The apparatus is adaptable for grinding and polishing the two faces simultaneously of a ribbon of glass as it advances continuously through the driving rollers. The patent contains 13 claims and 15 references were cited.

Glass Severing. Fig. 4. Patent No. 2,629,206. Filed August 1, 1949. Issued February 24, 1953. One sheet of drawings. Assigned to Corning Glass Works by James W. Giffen and Jay C. Overmeyer.

The primary object of the invention is to provide a means of cutting or severing of glass immediately following the formation of a hollow article.

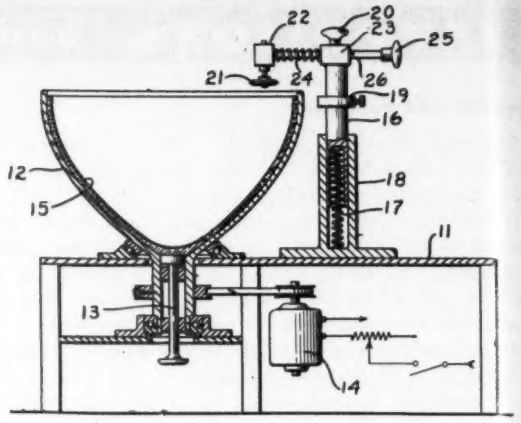

Fig. 4.

In Fig. 4 the mold 12 is equipped with a knock-out valve 13 and adapted to rotate by a motor 14 to centrifugally form the bowl 15 from a suitable gob of molten glass deposited therein. The severance of glass is accomplished immediately following formation of bowl 15 before the glass is set and while the mold is still rotating. Knob 20 is depressed to bring disc 21 to the level in mold 12 at which the groove in bowl 15 is to be formed. An outward pull is then exerted on handle 25, thus bringing the disc 21 into grooving relation with the wall of the bowl to form an annular groove therein as the bowl is rotated. After the groove has been formed, the grooving assembly may be permitted to return to its initial position under the influence of springs 24 and 17. Post 16 may subsequently be rotated in the bearing 18 to bring parts 21, 22, 24, and 26 clear of the mold 12 to enable ready removal of the bowl 15. The bowl may then be removed by a conventional vacuum take-out mechanism, or it may be made available for manual or mechanical seizure and removal by elevation within the mold by means of the valve 13.

The patent contains six claims and the references cited were: 2,349,046, Luertzing, May 16, 1944, and 256,767, Germany, Feb. 19, 1913.

Glass Burn-Off Machine. Fig. 5. Patent No. 2,629,205. Filed December 24, 1948. Issued February 24, 1953. Six sheets of drawings. John W. Eldred.

A novel burner and burner-control system is designed to use with various burn-off machines. It is especially applicable to the Eldred thirty-spindle tumbler burn-off machine (U.S. Patent No. 2,537,660). The primary object of the invention is to provide a flexible burner for producing a smooth small bead on the lip or rim of the tumbler from which the moil is severed.

The details of the burner are shown in Fig. 5. A plurality of such burners are carried by rings on each machine and each individual burner is properly aligned for the work at hand.

The burner provides one ring-like flame for melting, softening, and fire finishing the ware. This melting flame is preferably furnished by the lower burner member 55A. The burner provides a second ring-like flame for finally severing the moil from the ware. The severing flame is of a higher temperature and "sharpness" than the first. Suitable temperatures are 3000°F. for the first flame and 3500-4000°F. for the second. The two flames

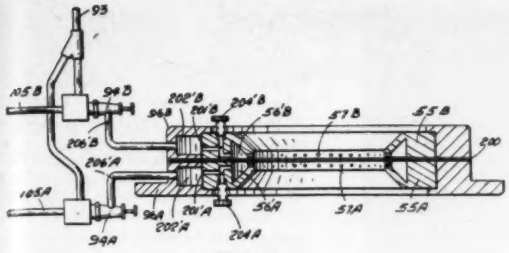

Fig. 5.

are separately regulated, with the following desirable results: first, the finish is brought completely under control; second, the bead or lip on the ware is smaller than that formed by prior art machines and methods; third, the severing operation is quickly performed and "jagged edge" rejects are minimized.

The melting flame is applied to the ware exterior section immediately above the moil, while the ware is being transported through the heating and stretching zones.

Each burner comprises a cap member 55B and a base member 55A, separated by an annular shim 200'. The cap and base members are of generally annular shape and cooperate with the shim to form internal circulating passages 56'A, 56'B, in communication with channels 201'A, 201'B. These channels communicate with mixing chambers 202'A, 202'B in mixer shells 96A, 96B, individually concentrically disposed about the burner members 55A, 55B.

Regulators 94A, 94B are tapped into the fuel supply line 93. Oxygen lines 105A and 105B are separately connected to the mixing chambers 202'A, 202'B, through the regulator chambers and pipes 206'A, 206'B.

The internal chambers 56B, 56A communicate with milled burner orifices or ports 57A, 57B. A plurality of such transverse ports are provided on the small-diameter faces of each of the main burner members 55A, 55B.

The patent contains three claims and 12 references were cited.

Furnaces

Glass Level Indicator. Fig. 6. Patent No. 2,625,593. Filed March 10, 1948. Issued January 13, 1953. Two sheets of drawings. Assigned to Frazier-Simplex, Inc., by James A. Voorhees and John Earl Frazier.

The details of the leveling device are shown in Fig. 6. In order to contact the glass surface, a horizontal bar 24 extends through a slot 23 and is threaded into block 19. A sleeve 25 of electrically insulating material is secured on the outer end of the rod by set-screws 26 and has a transverse slot 27 milled there through. A porcelain tube 28 is cemented in the sleeve and projects inwardly of the chamber 10 over a wall W. A platinum wire 29 extends through the tube. The inner end of the tube is bent down at right angles toward the surface of the molten glass indicated at 30 and the tip thereof is tapered as at 31. The bar 24 and tube 28 form an arm extending laterally from block 19 and downwardly toward the surface of the glass 30. The wire 29 terminates in a metal bead 32 which is exposed at the tip of the tube for contact with the surface of the glass, and thus constitutes a feeler or exploring contact means or element for collecting the electrostatic charge which accumulates on said surface.

The wire 29 has its outer end secured to a binding post 33 mounted on sleeve 25. A conductor 34 extends to any

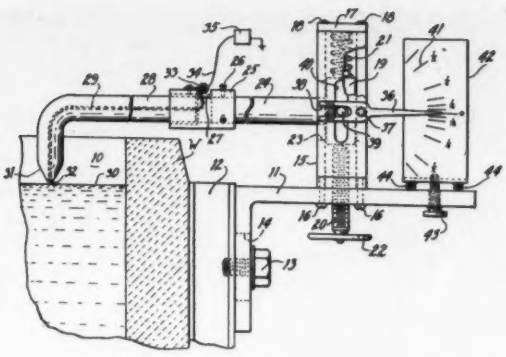

Fig. 6.

suitable form of translating means such as that comprising an indicating device responsive to a small electrostatic charge, an electroscope 35.

The electroscope may be used for energizing a circuit relay to automatically control a batch feeder and thus provide more or less raw batch to the tank as leveling device indicates the need. The device is said to be simple, direct-acting, and relatively inexpensive.

The patent contains five claims and the references cited were: 761,381, Hjorth, May 31, 1904; 1,961,893, Wadman et al., June 5, 1934; 2,032,016, Hitner, Feb. 25, 1936; 2,053,938, Barker, Sept. 8, 1936; 2,202,197, Ewertz, May 28, 1940; 2,380,436, Holdman, July 31, 1945; 2,423,888, Hueser, July 15, 1947; 72,404, Norway, Aug. 4, 1947; and 494,254, France, May 26, 1919.

Glass Level Gauge. Fig. 7. Patent No. 2,623,969. Filed July 18, 1950. Issued December 30, 1952. One sheet of drawings. Assigned to Emhart Manufacturing Company by Aaron K. Lyle.

An improved electrode is provided for use in a molten glass level gauging. The conventional electrode used for this purpose is complicated, expensive, and quite difficult to repair.

Fig. 7 shows a vertical section of the improved electrode positioned with its tip in contact with molten glass. In use, the electrode may be suspended from a suitable carrying means in order to move through the opening C-1 in the top of a refractory-walled structure.

The upper end of the wire 10, which is usually platinum, may be inserted through this passage 29 into the recess 28a in electrically conductive strip 28 and clamped to the strip by a screw 30. Attached to the electrically conductive strip 28 in an exposed position above block 27 is a terminal screw 32 extending through the horizontal supporting tube 24. This wire

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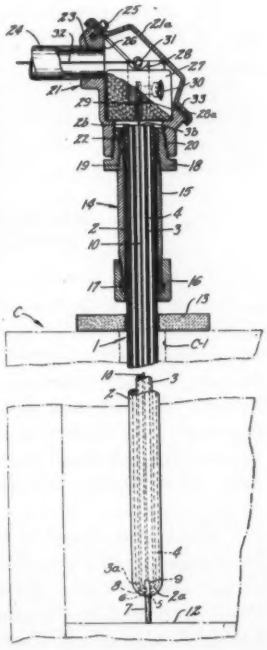
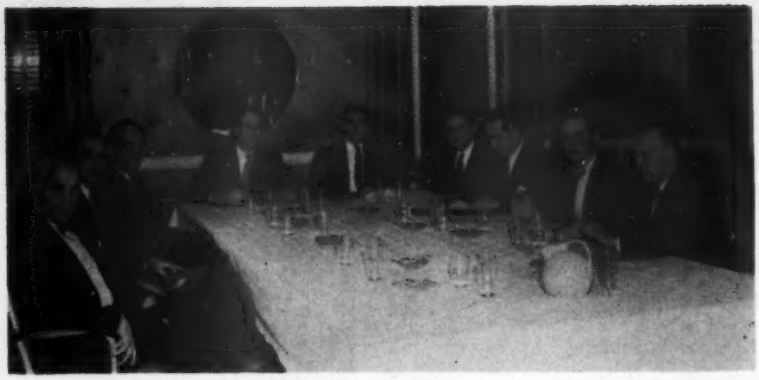


Fig. 7.



Members of the attending A.G.A. Glass and Ceramics Processing Subcommittee included, clockwise around the table: C. B. Cole, Rochester Gas & Electric Corp.; A. H. Navarre, Surface Combustion Corp.; M. O. Kaufman, Selas Corporation of America; R. C. LeMay, Chairman, Selas Corporation of America; D. E. Young and T. Z. Dunn, The Ohio Fuel Gas Company; H. C. Weller, Surface Combustion Corp.; R. L. Lang, The Ohio Fuel Gas Company; and S. G. Moran, Consolidated Gas Electric Light & Power Company of Baltimore.

GLASS AND CERAMICS COMMITTEE OF GAS ASSOCIATION HOLDS MEETING

A two-day meeting of the Glass and Ceramics Processing Subcommittee of the American Gas Association was highlighted by plant visitations to the Owens-Corning Fiberglas Corporation plant in Newark, Ohio, Pittsburgh Plate Glass Company's Mount Vernon, Ohio, plant, and Anchor Hocking Glass Corporation's Newark, Ohio, plant. The visiting committee men were particularly interested in the fire polishing, tempering, and annealing phases of the operations after the forming machines, which are the critical glass operations on which gas is used.

The committee also discussed topics to be presented in forthcoming Information Letters, which are published by the A.G.A., and it was decided to prepare one on Glass Melting.

B.L.S. TO PUBLISH ECONOMIC REPORT

A productivity "yardstick" that overseas glass container makers can use to compare their efficiency with U.S. operations is being prepared by the Federal Bureau of Labor Statistics as part of the U.S. economic aid program. It will probably be ready for publication about November.

The Bureau has just started collecting data from a selected group of U.S. glass container plants. Initially the overseas interest centered in Mason jars and beverage bottles, but field workers here soon found that it is impossible to segregate cost and output data into a limited number of containers being processed as part of a wide variety of ware made from the same basic ingredients. The final study, therefore, will reflect entire output of each plant.

Similar studies are being prepared for overseas use covering many light and heavy consumer-goods industries and in the tool and component parts fields. Individual plants are not identified in the published reports.

BAUSCH & LOMB APPOINTMENTS

C. Cala and M. Scott have joined the Chemical Research Laboratory of Bausch & Lomb Optical Company as Heads of the Laboratory's new Glass Process Development and Glass Engineering Departments, according to Norbert J. Kreidl, Chemical Research director.

Both Mr. Cala and Mr. Scott have been prominently engaged in a program of modernization in the company's Process Engineering Division, and are well-known members of the Glass Division of the American Ceramic Society.

Fred Hartter, Paul Sullivan, and John Mattern have been transferred from the Process Engineering Division to the Glass Process Development Department, and R. Plunkett to the Glass Engineering Department. L. Ohliger has been transferred from the Glass Physics Section to the Engineering Department.

IMPROVED MOLD SPRAY DEVELOPED

An improvement in mold spray oil, for use on high-speed glass container forming machines, has been developed by Gulf Oil Corporation. It is designed to keep the blank molds used in this operation properly coated and cleaner for longer periods of time, adding to efficiency and reducing shutdowns.

Named Gulf Moldgloss A, the product combines colloidal graphite, other additives, and the proper petroleum oil. These are formulated in the most effective percentages to maintain a uniform coating of carbon on the blanks, without excessive build-up of deposits, for long periods and over a wide range of operating temperatures.

Gulf Moldgloss A can be used under most conditions as a mold spray oil, and in certain cases as a swabbing compound, on automatic glass container forming machines. It can be also used as a concentrate or additive for blending with straight mineral oil stocks when spray oils with lower concentrations of colloidal graphite can be used satisfactorily. It is also suitable for general use as a lubricant on glass forming machines where a low viscosity oil containing colloidal graphite is required.

PPG FIBER GLASS FACILITIES TO BE COMPLETED SHORTLY

The Fiber Glass Division of Pittsburgh Plate Glass Company has already begun production in its new Shelbyville, Indiana, facility which will be completed shortly, accord- to The Rust Engineering Company, the engineer-constructor.

The new facility, converted by Rust from a former tractor plant, is being equipped to produce both the superfine fiber glass and the fiber glass yarn. Nine glass furnaces have been constructed to serve the fiber glass machines and both processes will use the direct melt method by which the glass filaments for the yarn and the staple fibers for the superfine insulation material are made from the initial melt.

The Measurement of the Devitrifieation Characteristics of Glass

All glasses have a tendency to devitrify over a certain range of temperatures. This tendency varies with the chemical composition of the glass and with temperature within the devitrification range. Although this phenonemon has been known for as long as glass has been made, very little fundamental work has been carried out in relation to its importance in glass manufacture.

It is convenient to describe the devitrification tendency of a glass in terms of certain characteristic points on the devitrification-temperature curve. On such a curve are the following important points: (1) the liquidus temperature, T_L, above which no crystallization will occur under normal conditions; (2) the temperature, T_M, at which maximum rate of crystal growth occurs. This turnover in the curve is characteristic of all super-cooled liquids and indicates a balance between two opposing processes, namely, the crystallization process and the increase in viscosity with decrease in temperature. For most glasses, the temperature interval between T_L and T_M is of the order of 50°-100°C. (3) the maximum rate of crystal growth R_M; (4) the area under the curve.

The quantities mentioned above are measures of the devitrification characteristics of a glass. They can be obtained experimentally, and provide the glassmaker with some very useful information. There measurement has shown that a more complete understanding of devitrification requires much deeper study, particularly into the process of nucelation, which is perhaps the most important feature of the divitrification process.

A knowledge of the liquidus temperature is of vital importance from the practical point of view. In any glassmaking process, it is undesirable to use a glass the liquidus temperature of which is near to or in the working range. In the general operation of glass melting units, it is essential to know the temperatures at which difficulties due to devitrification will occur. It is also necessary, from the practical point of view, to have a knowledge of the other characteristics T_M, R_M, and A. It is possible for two glasses of different compositions to have identical values of T, but to have completely different values for the other characteristics.

A. J. Milne, in the October 1952 issue of the *Journal of the Society of Glass Technology*, discusses the measurement of the devitrification characteristics of glass. The method previously used by the author was the graded-temperature furnace method, the liquidus temperature being determined by observing the position of the boundary between the glass and the crystalline phase, the corresponding temperature being obtained from the known temperature gradient which had been maintained along the sample. This method has, however, the following disadvantages: (1) it is tedious since microscopic sections have to be made in order to make any measurements on the rate of crystal growth; (2) with the more fluid glasses, there is a possibility of flow occurring and causing a movement of the boundary between the glassy and crystalline phases; (3) it is difficult to make accurate temperature measurements.

Table I

No. of Sample	1st run (40 min.) Temperature °C.	1st run (40 min.) Rate of Crystal Growth (Microns/min.)	2nd run (45 min.) Temperature °C.	2nd run (45 min.) Rate of Crystal Growth (Microns/min.)
1	831	1.64	830	1.60
2	845	2.08	846	2.15
3	850	2.26	867	3.11
4	898	5.20	885	4.09
5	909	6.20	898	5.33
6	919	7.05	903	5.78
7	950	10.67	934	8.36
8	958	10.75	940	9.15
9	961	10.00	969	7.73
10	967	9.00	980	6.25
11	971	7.95	997	2.5
12	985	5.00	1013	—

The present method, modified from one used by E. Plumat, consists of a vertical furnace designed so as to give a gradually increasing temperature down its length. Arranged in a circle of 4 inches diameter, in the cover are 12 tubes of impervious porcelain. These tubes are all of different lengths ranging from 2.5 to 8.0 inches in steps of 0.5 inch. Passing down the small holes in the tube are the thermocouple wires, the lower ends of which are welded to a ring made of platinum wire. This ring supports the sample holder and at the same time acts as a thermo-element. Inside the ring is placed a hollow cone of platinum foil which acts as the sample holder, the sample being introduced through the central hole in the tube.

In the experimental procedure, the empty platinum cones are placed in position in the rings directly beneath the central holes in the tubes and lowered into the furnace, which is allowed to come to a steady temperature. The temperature regulator is then put into operation and, when steady temperatures are being registered by all the thermocouples, the glass samples—about 0·05 c.c. of glass is sufficient—are dropped down the central holes of the tubes into the empty cones below. Because of their small size, the samples are heated up in a few seconds. The samples are left in the furnace until the crystals formed have reached a size which can be measured conveniently by a microscope. The duration of the period depends on the glass investigated. For a simple three-component glass, a period of 5 minutes is sufficient, while commercial sheet and plate glasses require about 1 hour. While the samples are in the furnace, the temperatures indicated by the twelve thermocouples are noted. One set of temperature readings is sufficient, since the furnace temperature is automatically controlled. However, to check the operation of the temperature controller, a four-point Micromax recorder is used to give a continuous record of the temperatures of four selected samples.

At the end of the test period, the sample tubes are

(*Continued on page* 228)

A. A. Bratton, Chief Consulting Engineer for Pennsylvania Glass Sand Corporation, examining some of the washed and screened sand at the Mapleton plant.

PENNSYLVANIA GLASS SAND ENGINEER MARKS FIFTY YEARS OF SERVICE

Ambrose A. Bratton recently celebrated his fiftieth year of service with the Pennsylvania Glass Sand Corporation. In 1902, Mr. Bratton joined the firm and has since served successively as mechanical engineer, district superintendent, chief mechanical engineer, and now as chief consulting engineer.

Over the past fifty years, Mr. Bratton has played a prominent role in the development of the operations of the company. In 1908, he designed and built the Keystone plant at Mapleton, Pa., and he has participated in the design and construction of a number of other plants for the company.

Mr. Bratton was born at Ryde, Pa., in 1877. After obtaining all the public school education it was possible to get at that time, he enrolled in a correspondence course in engineering and pursued it for several years, while at the same time getting his practical experience in the engineering end of the sand business as a master mechanic.

FERRO NAMES KEY SALES MEN

The appointment of John R. McCord and Donald R. Goetchius to new sales posts with the Ferro Corporation has been announced by C. D. Clawson, President of the firm.

Mr. McCord will assume the post of Manager of Ceramic Sales, while Mr. Goetchius will be Assistant Manager of Ceramic Sales. Formerly with Owens-Corning Fiberglas Corporation and Owens-Illinois Glass Company for 16 years, Mr. McCord was Appliance and Equipment Division Manager of the Fiberglas firm, prior to his new connection.

An employee of the Ferro Corporation since 1938, Mr. Goetchius is a two-time winner of the annual Robert A. Weaver Award for contributing the most to the progress of the Ferro Corporation. His previous business connections were with the U. S. Glass Company as Chief Chemist and the Ohio Brass Company where he was a research engineer.

A.C.S. SECTION MEETINGS

The Trenton Section of the American Ceramic Society held its annual dinner-dance, with approximately 100 members and guests in attendance. Preceding the dinner, the following officers were installed for 1953: *Chairman*, J. Talbot Smith, United Clay Mines Corp.; *Vice Chairman*, Elmer Miller, Washington Porcelain Company; *Secretary-Treasurer*, Harry Barr, Consolidated Feldspar Corp.; *Counsellor*, Ogden A. Kantner, United Clay Mines Corp.

At the annual joint meeting of the Pennsylvania Ceramics Association and the Philadelphia Section of the A.C.S., Penn State Night, part of the program included a Report on Current Ceramic Activities of the School of Mineral Industries, by E. C. Henry, Chief of the Division of Ceramics; Thermal Behavior of Aluminum Titanate, by N. R. Thielke, Research Associate in Ceramics; and Problems in the Field of Ferrites, by W. R. Buessem, Research Professor of Mineral Technology.

The April 14 meeting of the Pittsburgh Section will feature J. J. Svec, Assistant Publisher of *Ceramic Industry*, who will discuss the matter of research and its relation to sales.

William Cannon, Jr., of the Magnaflux Corporation, was the speaker at the March meeting of the Central Ohio Section of the American Ceramic Society. Mr. Cannon spoke on "Non-Destructive Testing of Ceramic Materials." Charles Lux, President of the Central Ohio Technical Foundation, outlined the progress of the Foundation since its inception, and told of its latest plans.

ABRASIVES SYMPOSIUM

An Abrasives Symposium is scheduled for June 8 through June 26 at Alfred University, according to Dean John F. McMahon of the College of Ceramics. Leon B. Bassett, Associate Professor of Reasearch, will be coordinator of the session.

A part of the summer education program, the course will consist of approximately 40 lectures by men associated with the abrasives industry. The symposium will be conducted during Intersession, immediately following commencement and preceding summer school.

GLASS DECORATION EXHIBIT ORGANIZED BY CORNING

The second of a series of traveling exhibitions, organized by The Corning Museum of Glass, is entitled "The Story of Glass Decoration."

The exhibition consists of over a hundred items of which more than forty per cent have never before been shown to the public. It illustrates the evolutions of eight basic methods of glass decoration: enameling, thread decoration, applied glass, mosaic, mold blowing, cutting, gilding, and cameo. These methods were all in use at least 1,700 years ago, and the exhibits range from objects made as early as 800 B.C. to examples of 20th century glassmaking. The actual processes used in producing these eight types of glass decoration are explained by a series of diagrams.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during January 1953 was reported at a preliminary 134,700. This is an increase of only .2 per cent over the previous month's adjusted 134,000. During January 1952, employment was 119,500, which is 12.7 per cent less than for January this year.

Payrolls during January 1953 were just slightly under the previous months. January payrolls were a preliminary $43,567,368, or .1 per cent below the $43,650,880 paid out during December 1952. During January 1952, payrolls were reported to be $34,378,955, or 26.7 per cent less than for January this year.

Glass container production, based on figures released by the Bureau of Census, fell off during February 1953 to reach 9,000,228 gross. Compared with January production of 9,292,650 gross, a drop of 3.1 per cent is shown. Production during February 1952 was 8,782,780 gross, which is 2.4 per cent less than for February this year. At the end of the first two months of 1953, production of glass containers has reached a total of 18,292,878 gross, which is 3.2 per cent higher than the 17,723,511 gross produced at the end of the first two months of 1952.

Shipments of glass containers during February 1953 also fell off and were reported to be 8,670,985 gross. This is 1.8 per cent below the 8,836,534 shipped during January. Shipments during February 1952 were 8,277,376 gross, which is 4.7 per cent lower than for February 1953. Total shipments of glass containers at the end of the first two months of 1953 are 17,507,519 gross. Compared with the 16,940,209 gross shipped at the end of the first two months of 1952, a difference of 3.3 per cent is shown.

Stocks on hand at the end of February 1953 were 10,677,214 gross, which is 2.3 per cent higher than the 10,427,036 gross on hand at the end of January and 5.7 per cent higher than the 10,092,837 gross on hand at the end of February 1952.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

	February, 1953
Narrow Neck Containers	
Foods	825,168
Medicinal & Health Supplies	1,195,873
Chemicals, Household & Industrial	674,824
Beverages, Returnable	459,282
Beverages, Non-returnable	37,606
Beer, Returnable	144,710
Beer, Non-returnable	427,140
Liquors	616,187
Wines	312,423
Toiletries & Cosmetics	541,736
Sub-total (Narrow)	5,234,949
Wide Mouth Containers	
Foods	*2,244,271
Dairy Products	211,655
Medicinal & Health Supplies	397,655
Chemicals, Household & Industrial	129,068
Toiletries & Cosmetics	134,434
Packers' Tumblers	158,410
Sub-total (Wide)	3,275,493
Total Domestic	8,510,442
Export Shipments	160,543
TOTAL SHIPMENTS	8,670,985

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production February 1953	Stocks February 1953
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	3,350,482	3,676,652
	Wide Mouth	3,060,110	3,376,874
Dairy Products		253,073	374,820
Beverages, Returnable		687,433	1,113,949
Beverages, Non-returnable		21,266	77,821
Beer, Returnable		205,831	275,737
Beer, Non-returnable		408,213	413,848
Liquors		567,736	835,760
Wines		286,028	392,617
Packers' Tumblers		160,056	139,136
TOTAL		9,000,228	10,677,214

Automatic tumbler production during January 1953 jumped 20.4 per cent to reach a total of 5,975,243 dozens. This is an increase over the previous month's production total of 4,959,897 dozens. Production during January 1952 was 4,882,873 dozens. Shipments of automatic tumblers also jumped to reach 5,399,067 dozens. This is an increase of 21.9 per cent over December 1952 shipments of 4,428,085 dozens. During January 1952, shipments were 4,472,982 dozens. Stocks on hand at the close of January 1953 were 8,723,606 dozens, which is 2.1 per cent less than the 8,910,823 dozens on hand at the close of December 1952. Stocks at the end of January 1952 were 11,836,503 dozens.

Automatic tumbler production during February 1953 continued on the upswing and was 6,387,101 dozens. This is 6.8 per cent above the January production. During February 1952, 5,136,363 dozens were produced. Shipments during February 1953 also continued upward. They were 5,540,919 dozens, or 2.6 per cent over the 5,399,067 dozens shipped during January. Shipments during February 1952 were 5,514,484 dozens. Stocks on hand at the end of February 1953 were 9,565,984 dozens. This is 9.6 per cent over the 8,723,606 dozens on hand at the end of January. Stocks at the end of February 1952 were 9,988,546 dozens.

Table, kitchen, and household glassware: Manufacturers' sales of machine-made table, kitchen, and household glassware during January rose 10.8 per cent for a total of 3,652,091 dozens. During December 1952, sales were 3,295,469 dozens. Sales during January 1952 were 3,005,025 dozens. At the close of the 12-month period ending January 1953, manufacturers' sales reached a total of 41,783,974 dozens, which is 8.5 per cent over the 38,477,714 dozens sold during the corresponding period in 1952.

During February 1953, manufacturers' sales were 3,655,728. This is only the smallest fraction of a per

(*Continued on page* 232)

New Equipment and Supplies

HAND POLARISCOPE

The Pacific Transducer Corporation, 11921 West Pico Boulevard, Los Angeles 64, California, has announced the development of a new hand polariscope for use in the laboratory and factory for the detection of strains in glass and plastics.

In the laboratory, the instrument affords a ready means of checking for strains in chemical glassware and for the determination of the axes in crystal formations. In industry, it can also be used for the detection of strains in glass-to-metal seals and in clear plastics.

The Model 242.3 hand polariscope is made with an oxidized non-rusting metal frame. The polarizer is fixed in one end of the frame. The analyzer is rotatable through 180° in the other end of the frame. There is a 3¼" space between ends for the object under examination. Any source of moderate intensity light is sufficient for the detection of strains in glass and clear plastic, and the quick inspection of glass molds and seals. The filters are made of 3" scratch resistant Polaroid.

WET BLASTING MACHINE

American Wheelabrator & Equipment Corporation, 1026 S. Byrkit Street, Mishawaka, Indiana, has announced the addition of a new model to its line of wet blasting machines.

Known as Model 30 Liquamatte, it is intended for precision cleaning and finishing applications involving small pieces that can be lifted and handled manually, such as in the manufacture of glass, plastic, and small rubber molds; die-casting dies; reconditioning plant equipment such as oil burners; surfacing tools such as drills, reamers, etc.

The machine, 2' 6" in length by 2' 6" in width by 6' 11" in height, has a blasting compartment 30" square and 1' 7" high. A 15" diameter rotating work table is available for holding the work in the blasting compartment, and small portable auxiliary tanks are available to receive the parts from the blast chamber for rinsing.

Fine mesh abrasives, suspended in water, are propelled at the work by compressed air. The abrasive slurry is made up of 25 lbs. of abrasive and 5 gallons of water. Since such fine mesh abrasives are used, close-tolerance dimensions are maintained and sharp corners, lines, and lettering in patterns remain undamaged. Flat surfaces, knurling, thin-walled sections, and other normally vulnerable areas remain unchanged. Tolerances of .0001" can be maintained where required.

8000o ARC TORCH

Eutectic Welding Alloys Corporation, ChemoTec Division, Flushing, New York, has announced the development of an arc rod which can be used upon non-conductive material and without a ground connection.

The DynaTrode creates its own arc. It requires no ground and it does not have to be struck upon metal. The operator has complete control at all times and he alone determines when and where the arc will start. The arc, which will operate in mid-air, as well as it will upon stone, resembles a flame in appearance. It has all the characteristics of a super torch flame from 5 to 8-in. in length.

Technically, DynaTrode is a self-energizing arc rod. The heavy coating is reduced more slowly than the core. This forms a crucible or tube of coating through which the energy is concentrated into a fine tip and its character has been changed by the disintegrating coating. The thermal ionization of the coating by the arc stream, combined with the concentration, produces the conditions necessary to pierce and melt the refractory material.

These are properties of formulation and electrical and thermal equilibrium which produce a pre-determined thermo chemical inter-reaction between the process of electrode disintegration and the components of the refractory material. A conventional welding machine and a supply of DynaTrode rods are all the equipment required.

RUBBER CLEAT FOR GLASS-RACK BODIES

H. Barkow Company, 153-165 N. Milwaukee Street, Milwaukee 2, Wisconsin, has developed a new Barkleat glass holder which will securely clamp the glass plates on a glass truck with minimum road shock during transportation.

Barkleats are triangular cleats of hard rubber edged with soft rubber which mount to the vertical stakes with wing nuts and bolts. One of the soft rubber edges hugs the glass and stays in place due to the triangular shape. A wedging action toward the glass develops, even though the wing nut may be loose. Rubber, however, has a lock washer action which minimizes loose wing nuts.

NEW GAS BURNER

North American Mfg. Company, 4455 East 71st Street, Cleveland 5, Ohio, has introduced a new, nozzle mixing type of gas burner called the Series 123XSA Gas Burner.

The new burner is offered in five sizes, and shipped with mounting and tile already assembled in an integral unit for easy installation. The tile is firmly cemented into a cast iron jacket 1¾" deep, and then held securely in place with hooks to prevent any leaking between the tile and casting, which would cause the furnace shell to overheat and buckle. The burner has provision for a standard North American pilot system, and a conduction type flame safety device may be added at the factory if specified on the order.

XSA burners have a high effective turndown, making them suitable for installation on multiple purpose furnaces. A furnace equipped with these burners can be operated at temperatures from 400° F. up through temperatures used for annealing and hardening processes.

CATALOGS RECEIVED

The Cambridge Wire Cloth Company, Cambridge, Maryland, has published a 132-page catalog featuring its conveyor belts for the processing of industrial products.

The extensive catalog discusses the various applications of Cambridge conveyor belts in the numerous industries served. Types of belts are illustrated and discussed, as are sectional belting, weights, balanced belting, rod-reinforced belting, belt guides and drive, etc.

Wall-Colmonoy Corporation, 19345 John R Street, Detroit 3, Michigan, has published a new 4-page two-color illustrated folder describing properties, application methods, and typical uses of Colmonoy No. 1 hard facing welding rod.

Included in the folder are line drawings showing application methods, in addition to illustrations of oil refinery catalyst slide valves and stone mill hammers that have been wear-proofs with No. 1 alloy.

Hauck Manufacturing Company, 124-136 Tenth Street, Brooklyn 15, New York, has made available a new 12-page Catalog No. 805A produced for users of gas-fired industrial furnaces, ovens, kilns, driers, etc.

The catalog describes the simultaneous controlling and accurate proportioning of air and gas with a single control valve for manual or automatic operation. A consistent air-gas ratio is maintained over the entire range of the mixer capacity. The self-locking feature of the mixer control adjustment eliminates changing of mixture caused by hand locking adjustments. Mixer capacity tables are given for five different kinds of gases and for eight air pressure ratings.

Decorator increases capacity 20%, Decreases handling 25% . . .

with CAMBRIDGE wire mesh conveyor belts

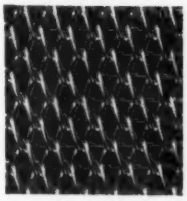
A large producer of medical and biological glassware wanted to boost capacity and efficiency in decorating his product. The cumbersome, two-pass system formerly used required excessive handling, forced high maintenance costs of special fire clay holders, held production rates far below customer demand.

Cambridge engineers, working with the customer's staff, designed the special 6 lane wire mesh conveyor belt installation shown here. Ware to be fired is placed on the belt from six decorating stations at the feed ends of the belts. The moving belts carry the ware through a standard one-pass decorating lehr at 1200° F., completely eliminating manual handling during firing. Specially crimped rods mounted across the belt to hold the ware eliminate the need for fire clay holders. Oxidation resistant alloy wire used in weaving the belt reduces marking of the ware. Open mesh of the belt allows free heat circulation within the lehr, assures uniform production, reduces rejects.

By actual comparison, this Cambridge belt installation allows 3 operators to service 6 loading stations, whereas the former method required 4 operators for only 5 stations!

There's a Cambridge wire mesh conveyor belt for practically any glass or ceramic process that can be combined with movement . . . annealing, decorating, feeder lines, cooling . . . as well as for general use such as for storage or cullet conveyors.

Call in your Cambridge Field Engineer for a discussion of how wire mesh belts can solve your production bottlenecks. Look under "Belting-Mechanical" in your classified telephone book for the Cambridge man nearest you, or write direct.



Cambridge Rod Reinforced Belting is widely used in glass and ceramic plants. It combines high tensile strength with low thermal capacity, assures straight belt travel and resists distorting strains.

FREE BELT MANUAL illustrates and describes wire mesh belts for your industry. Also includes useful metallurgical tables and data on conveyor design and installation. Write for yours

The Cambridge Wire Cloth Co.

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WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

LACLEDE-CHRISTY APPOINTS GENERAL SALES MANAGER

J. Douglas Streett, President of Laclede-Christy Company, has announced the appointment of Harvey R. Hiller as General Sales Manager of the company, replacing John L. Cummings, resigned.

Mr. Hiller, a graduate of Carnegie Institute of Technology, joined the company 30 years ago as a Sales Engineer, and was subsequently named District Sales Manager, Regional Sales Manager, and Assistant Vice President-Sales.

Mr. Cummings leaves Laclede-Christy to become Vice President and Sales Director of the Davis Fire Brick Company.

AMERICAN POTASH & CHEMICAL APPOINTMENTS

Three new appointments in the Sales Department of American Potash & Chemical Corporation have been announced by Wm. J. F. Francis, General Sales Manager, Western.

Harrold J. Bensinger was named Sales Manager of the Heavy Chemicals Department, Western; Albert F. Swain was appointed Sales Manager of the Agricultural Chemicals Department, Western; and George A. Schnier become Sales Manager, Refrigerants Department, Western.

MARIETTA CONCRETE TO OPEN NEW PLANT

The Marietta Concrete Corporation has announced the incorporation of The Marietta Concrete Corporation of Florida. The new plant will be located at Hollywood, Florida. F. L. Christy, President of Marietta, will head the new Florida firm.

The plant, which will have an authorized capital of $250,000, will manufacture mortarless concrete block, precast concrete wall panels, and farm and industrial silos. When completed, it is expected that the Florida plant will employ 200 production workers, including key men from the Marietta, Ohio, plant during the initial operating period.

BRISTOL NAMES VICE PRESIDENT—SALES

Harry E. Beane has been appointed Vice President of Sales of The Bristol Company, according to an announcement by William H. Faeth, President of the company.

Mr. Beane joined the Bristol sales engineering organization in 1920 and in 1925 was appointed district manager of the company's Birmingham, Alabama, office. In 1930, he became District Manager of the Pittsburgh district, later becoming Sales Manager of the company's Instrument Division and General Sales Manager.

• DESIGN
• ERECTION
• OPERATION

of Glass Plants

DOMESTIC AND FOREIGN

Complete Glass Plants and Equipment, Batch Systems, Glass Melting & Sodium-Silicate Furnaces, Batch Feeders, "Schmid" Mechanical Gob Feeders, "Liberty" Pneumatic Gob Feeders, Automatic Handling Equipment, Stackers, Lehrs, Machines, etc. for manufacture of containers, flat glass, pressed ware, and tubing. Furnace Repairs and Rebuilding. Process Engineers.

ARTHUR W. SCHMID COMPANY

ENGINEERS AND CONTRACTORS

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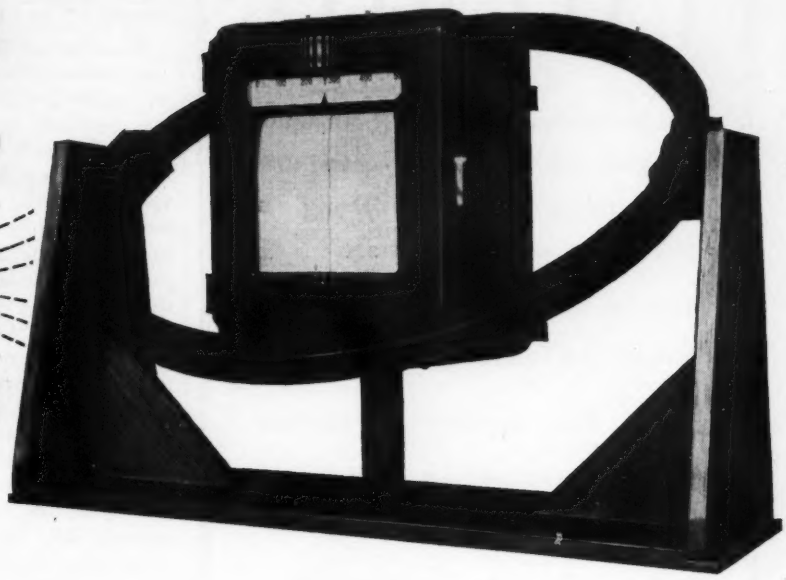
Speedomax is engineered for FIELD service

Here's how L&N engineers verify Speedomax resistance to stray electrical fields. The ring is a Helmholtz coil, adjustable for a wide variety of field effects.



• Built into every Speedomax recorder and controller is a high degree of indifference to stray electrical fields. And this is one of its most useful characteristics in almost any job. It means that you can install a Speedomax near a big motor, power line or X-Ray machine—any electrical equipment in fact—and you'll probably see no effect at all from surrounding electronic noise and "junk".

The reason for this indifference to stray fields goes back through the adjustment, building and design of the instrument, to its basic engineering. Speedomax has an *electronically-clean measuring circuit*, as well as clean signal and amplifier circuits.

This clean design includes a bifilar-effect slidewire, to eliminate any objectionable inductance at that point. It includes our "no-moving parts" trolley contact on the slidewire, which eliminates pigtails and their variable inductances. It includes use of a Mumetal slidewire shield where desirable, instead of less expensive but lower-permeability aluminum. And it includes a lot of just downright meticulous detailing, such as carefully engineered wiring and input filtering, plus ingenious shielding where required.

These and other precautions eliminate out-of-phase components in the supply to the amplifier. The latter therefore doesn't "load"; hence sends the correct amount of correct-phase power to the balancing motor. With ample power, the motor's recording and control action is snappy and accurate.

Our Catalog ND46(1) and Technical Publication ND46(1) tell the story. Write our nearest office or 4945 Stenton Avenue, Philadelphia 44, Pa.

Ceramic engineers and the makers of portland cement, table ware, glass, etc., find that Speedomax instrument operation is not affected by the stray fields created by nearby power lines, motors, magnetic separators and so on.

PHOTO COURTESY LOUISVILLE CEMENT CO.

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LEEDS NORTHRUP

instruments automatic controls • furnaces

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CALUMITE

has established itself as an outstanding glassmaking material — one that really meets the most exacting requirements in colored glasses.

This material has been proven to provide the following advantages:

(1) Low cost source of alumina

(2) Easier melting

(3) Uniformity

(4) Better glass quality and higher production

(5) Plants well located for low freight charges

(6) For the first time positive control can be maintained over quality since Calumite affords a method of mathematical approach to glassmaking.

Many companies are finding that Columite is the answer to their colored glass problems. Although supply is now limited, we expect to be able to meet demand in the very near future.

Your inquiries are solicited.

The Calumite Co.
HAMILTON, OHIO

STONES IN GLASS . . .
(*Continued from page* 194)

curred at some area where the temperature was below 1705°F.

The other method of locating the source of devitrification troubles depends on examining the shape of the crystals in the devitrified glass. Crystals that are growing in size generally have definite regularly shaped ends as shown in Fig. 6. On the other hand, if the crystals which have once formed are heated above the liquidus temperature, the crystals will start dissolving and have a "punky" looking structure (as illustrated in Fig. 7). In this latter case, the crystallization probably occurred at some location more remote from the machine than with the first case.

(e.) Report. A final report on the stone identification is essential for the organization of the data and the preservation of some type of stone library. Often the petrographer will find that it is necessary to re-examine the slides when he starts putting the results down on paper.

Unfortunately the information that the furnace operator desires—what part of the tank the stones are coming from—can only be a well-qualified guess on the petrographer's part, while most of the observations that the petrographer is sure of—the identity of the phases present—are of little interest to the furnace operator. It is desirable to include the factual observations along with the conclusions drawn in the report.

Some diplomacy may be necessary in the final report. It is usually best not to include the operator's poor guess, if he made one in sending in the stone, but include his opinion if right. It is also essential to use the same terminology as used in your own plants.

Summary

The difficulties inherent in stone investigations have been pointed out. The assistance of the factory personnel is solicited in furnishing adequate data with the stones, stones from unknown sources whenever possible, and a complete criticism of the final report. Detailed directions are included for taking stone samples and sending them to the laboratory.

Some suggestions are offered to the petrographer in examining the stones, making slides, examining the slides, interpreting what is seen, and writing the final report. Means of locating the source of silica refractory stones and devitrification stones are presented.

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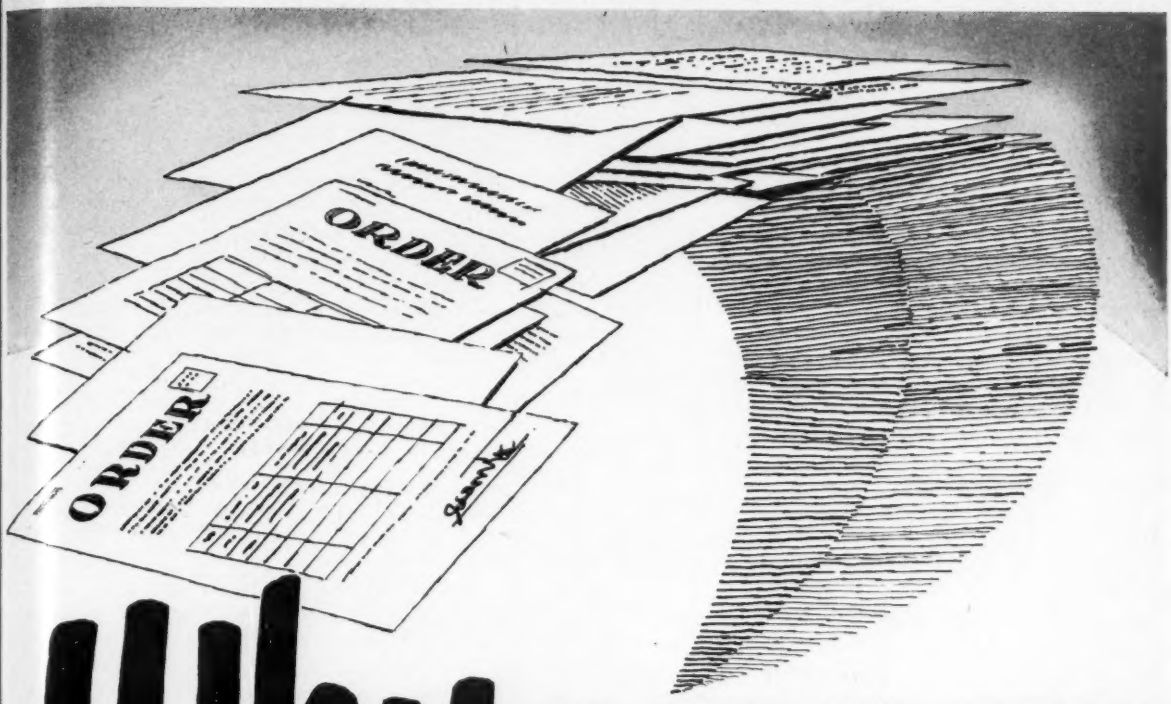
• Armour Research Foundation of Illinois Institute of Technology plans to move its expanding administrative headquarters into the five-story Arcade Building at 10 West 35th Street, Chicago, Illinois.



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INVENTIONS AND INVENTORS . . .

(*Continued from page* 211)

may lead to suitable electrical means (not shown) for passing current from a source through the wire 32, connecting strip 28, wire 10 and electrode tip 9-8-7 to the molten glass when the electrode tip has been lowered to the surface of such glass.

If the refractory tubes are broken, they may be easily replaced. The repair can be effected simply by removing the electrode from its place of use, separating the components, removing the broken tubes, and substituting new ones.

The patent contains 5 claims and the references cited were: 2,053,938, Barker, Sept. 8, 1936; 2,382,516, Sprague, Aug. 14, 1945; and 2,501,787, Rickmeyer, Mar. 28, 1950.

Glass Wool and Fiber

Bonded Mineral Wool. Patent No. 2,619,475. Filed August 30, 1951. Issued November 25, 1952. No sheets of drawings. Assigned to Owens-Corning Fiberglas Corp. by Louis A. Kovreg.

This invention relates to an improved binder composition for use in bonded mineral wool products. Furfuryl alcohol reacted in aqueous medium at elevated temperatures has been used but has a number of objectionable features such as brittleness, poor weathering properties and instability. Improvements have been made by the use of emulsifying agents such as carbamate of starch.

A typical formulation is as follows:

Example 1

12 pounds furfuryl alcohol
6 pounds glucosan monocarbamate
500 cc. 1.84 specific gravity sulphuric acid
Water in amounts to make up 130 gallons.

After the binder composition has been applied, the mat is caused to travel over a suction box and then passed through an oven maintained at a temperature of about 550-600°F. for a time ranging from ½ to 1 minute.

The patent contains eight claims and the references cited were as follows: 2,538,903, Gaver, Jan. 23, 1951.

1953 A.G.A. INDUSTRIAL GAS SCHOOL

Announcement has been made of the 1953 American Gas Association Industrial Gas School to be held during May 4 through 8 at The Sheraton-Cadillac Hotel, Detroit, Michigan.

A carefully selected group of lecturers from utility companies, equipment manufacturers, and industrial organizations will give beginners the fundamental knowledge required for a successful career in industrial gas sales. Experienced men will also find the school a valuable refresher course. Employees of industrial gas equipment manufacturers and dealers, plant engineers, or others from present or prospective consumers, as well as all gas company men, are eligible for enrollment.

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KERR APPOINTS NEW SALES MANAGER

J. Burton Tripp has been promoted from the position of District Representative of the Los Angeles area to Sales Manager for the entire Packer's Ware Division of Alexander H. Kerr & Co., Inc.

In announcing this promotion, Mrs. Alexander H. Kerr, President of the firm, states that, in addition to his new duties, Mr. Tripp will supervise the expansion and training of the commercial glassware sales force for the Kerr organization, which has plants located in Santa Ana, California, Sand Springs, Oklahoma, and Huntington, West Virginia.

G.B.B.A. PURCHASES NEW BUILDING

A modern, 18-story air-conditioned building in the heart of Philadelphia has been purchased by the AFL Glass Bottle Blowers Association of the U. S. and Canada as its international headquarters. The union now occupies the entire fifth floor with modern offices for the officers, research and education department, bookkeeping and secretarial departments, and a conference room.

Of the seventeen remaining floors in the building, twelve are now completely rented and the balance will be leased as soon as renovation is completed.

FRANKLIN GLASS APPOINTMENTS

Mrs. Jean Allen, associated with Franklin Glass Corporation since its inception, has been appointed by the Board of Directors as Assistant Secretary and Treasurer. She will be in charge of the Accounting and Purchasing Departments.

It has also been announced that Jean Munier has been appointed Assistant General Manager. Miss Frances A. Peaco, who has also been with the firm since its inception, has been appointed Assistant Manager in charge of the Sales Department.

KIMBLE GLASS TO TAKE OVER SAYREVILLE PLANT

Kimble Glass Company, subsidiary of Owens-Illinois Glass Company, will develop one of the most modern television bulb manufacturing centers at Sayreville, New Jersey. A plant, presently used by the company's Kaylo Division, will be taken over by Kimble.

The manufacture of television bulbs will start after the work of remodeling and equipping the Sayreville plant is completed in September. As additional furnaces and equipment are added, the output will approximate 150,000 television bulbs per month. By April 15 some television bulbs, shipped from other Kimble plants, will be completed at Sayreville. When fully converted, the new plant will handle every phase of television bulb manufacturing from the production of glass to the forming and assembling of the bulb.

HOUZE PRESENTS NEUTRAL SUNGLASS

The L. J. Houze Convex Glass Company has announced the development of the first neutral sunglass lens which will not distort color perception of the wearer and which can be mass produced for popular priced sunglasses.

E. V. Ogg, Executive Vice President, said the new neutral lens was eight years in development. Research was prompted by the investigations of the Army-Navy Vision Committee in World War II which recommended a lens "essentially neutral" in color as ideal for military personnel.

While the glass was made experimentally in small batches some time ago, the problems of color control in large quantities delayed achievement of a formula for mass production until now.

Dr. R. H. Peckham, Houze Director of Research, and former member of the Army-Navy Vision Committee, explained that because neutral shade is a combination of many colors, it is more difficult to control in mass production than tints of such colors as greens, yellows, blues, and brown which are on the market today. Dr. Peckham said that the new lens, known as Natural View, is slightly darker than many of the sunglasses on the market today in line with recommendations of eye specialists who have studied glare protection needs. He said that a slight amethyst tint has been added to the neutral which gives a pleasing quality.

BAUSCH & LOMB LABORATORY MANAGER NAMED

The promotion of Lee C. Becker to Manager of laboratory operations in Bausch & Lomb Optical Company's 155 branches throughout the U. S. has been announced by Ben A. Ramaker, Ophthalmic Division Manager. He succeeds Roy O. Pennock, who was recently promoted to Vice President and General Manager of Bausch & Lomb Optical Company Ltd. of Canada.

In his new post, Mr. Becker will assist in the development of the firm's ophthalmic sales program, and have charge of training branch managers in all phases of laboratory operations. He will also act as production consultant to independent distributors on methods, equipment, and training of laboratory technicians.

Mr. Becker joined Bausch & Lomb in 1945, and served as sales training director until 1947 when he became assistant ophthalmic machinery sales manager. In 1950, he was promoted to assistant manager of laboratory operations.

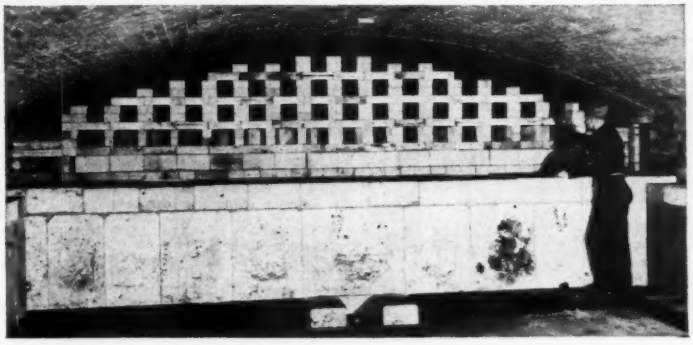
CARBORUNDUM APPOINTMENTS

Fred W. Bonacker, General Manager of The Carborundum Company's Industrial Abrasive Sales Division, has announced the following personnel changes: Russell P. Colosi, formerly Office Manager for the Cleveland office, has been appointed Assistant to the Cleveland District Sales Manager.

Charles J. Walter was transferred from the position of Office Manager of the Los Angeles District to Office Manager of the Cleveland District. Succeeding Mr. Walter is Wilfred Robson, formerly Assistant Office Manager in Chicago. Joseph A. Marrone, former Chief Stock Clerk at Chicago, will succeed Mr. Robson in Chicago.

The trend is to **MONOFRAX** **FUSED CAST** *refractories*

The extra-high purity and durability of MONOFRAX refractories are real assets to this best quality tank crystal. Type "MH" is used for the bridgewall, throat, sump, and doghouse sidewalls. Type "H" is used for the tuckstones and port bottoms for the full length of the tank; also for the port jambs and breastwalls through the first two (of four) ports. Gas is the fuel, with oil standby.



HOW FAST A BLOCK ERODES is largely determined by the composition of the interface, that thin film between the refractory and the glass. The greater the viscosity of the interface, the slower the erosion. The interface formed by MONOFRAX MH fused cast refractories, for example, slows the flow of glass adjacent to the refractory to 1/40 or 1/50 the rate in the melting end of the tank! This is due to the fact that MONOFRAX MH refractories are practically pure alumina (over 98%), which results in a high-viscosity interface. The physical structure of this refractory — a combination of interlocked alpha and beta alumina crystals — also helps make it one of the densest, longest lasting refractories available. Moreover, its high alumina content insures maximum glass purity. The impurities in MONOFRAX MH refractories total less than 0.07%. It is *the purest of all* commercial refractories for glass furnace use.

PENNSYLVANIA — A company making clear, high-quality container glass, including medicinal ware, recently installed 5 MONOFRAX MH feeder channels complete except for the bowl. This refractory was selected because of its purity — hence no adverse effect on glass quality — and its resistance to erosion.

CARBORUNDUM

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ELECTRICAL GLASS MELTING . . .

(*Continued from page* 208)

Examples of data for fuel-fired melting furnaces are given in Table I. These can be used as reference points in a complete calculation.

Conditions for Economy

Conditions for the economical use of electrical melting furnaces require that, at a maximum cost for energy, $r_e(max.)$, the full cost of the glass must not be higher than with other furnaces. In the form of an equation:

$$S_e \leqq S_g \text{ or } S_e \leqq S_h$$

(e refers to elec., g to gas, h to heating oil)

From these conditions and the formulas given above, the maximum price $r_e(max.)$ of electric current can be estimated, at which equality with the economy of other methods of heating will exist. If the electric furnace is to be profitable, the price to be paid for current must not exceed $r_e(max.)$.

Using the bases of Table III, as well as the uniformity of B, t, i, and q in accordance with earlier discussion, the following simplified equation for calculating the highest permissible price for current can be applied:

$$r_e(max.) \leqq \frac{a_g \cdot r_g}{a_e} + \frac{63 \times 10^{-4}}{a_e}, \text{ or}$$

$$r_e(max.) \leqq \frac{a_h \cdot r_h}{a_e} + \frac{43 \times 10^{-4}}{a_e}, \text{ in monetary units per Kw.hr.}$$

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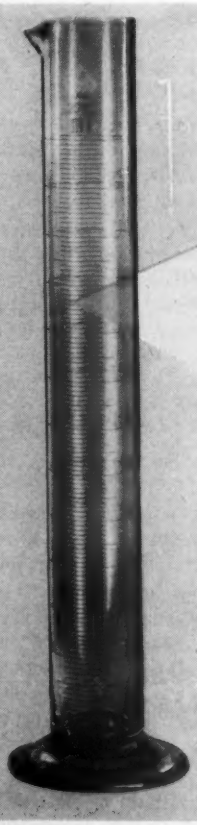

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*PATENT APPLIED FOR

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RESEARCH DIGEST . . .
(*Continued from page* 213)

quickly withdrawn from the furnace. The platinum cones are removed from the rings and unwrapped from the glass sample, which is placed in a small conically shaped hole drilled in a glass plate. The hole is filled with monochloro-benzene and the sample examined under the microscope for crystals. Samples which have been maintained at temperatures above the liquidus temperature will show no crystals, while samples maintained at temperatures below the liquidus temperature will show crystals, the size of which will depend on the temperature at which they have been growing. The size of the crystals is measured by means of a Beck micrometer eye-piece reading to 0·01 mm. in the image plane.

The type of result obtained is shown in Table I, the glass under investigation being a simple soda-lime-silica glass having the theoretical percentage composition 72 SiO_2, 16 Na_2O, 12 CaO.

When these results are plotted graphically (one curve can be drawn through both sets of results), it is found that

T_L, the liquidus temperature = 1010°

T_M, the temperature of maximum rate of crystal growth = 955°

R_M, the maximum rate of crystal growth = 11.0 microns/min.

This method has been used to study the devitrification of many glasses in the soda-lime-silica system and has met the requirements of speed, avoidance of flow, and the accurate determination of temperature.

In a second method which was described, a simple high-temperature microscope is used and measurements of the rate of crystal growth can be made while the crystals are actually growing. This method is of particular value for studying the devitrification of opal glasses.

O-I TO BUILD WAREHOUSE

A modern warehouse, that can store millions of glass containers, will be built on the outskirts of Atlanta by Owens-Illinois Glass Company, according to a recent announcement. The site is an 80-acre tract in Fulton County, directly north and west of the intersection of Sylvan Road and the Central of Georgia railroad tracks. It has a 3,000-foot frontage on Sylvan Road.

The warehouse will be a one-story, fireproof, steel structure with exterior walls of corrugated asbestos and a roof of lightweight Kaylo deck material. An outstanding feature is the lighting of the 160,000 square feet of floor space which is designed to give maximum visibility and efficiency. Panels of glass block in the exterior walls direct daylight to the ceiling to be reflected down on work areas. Rows of electric lights down each aisle will be arranged in patterns so as to throw light down on the aisles and deep into the storage areas.

• Diamond Alkali Company has announced that the name of its subsidiary, Kolker Chemical Works, Inc., has been changed to Diamond Alkali Organic Chemicals Division, Inc.

Nature's Gift to Industry

Powdered Silica of the highest Quality results from grinding these pure Ottawa and Rockwood sands.

• The Silica Sands of Ottawa and Rockwood, purified by nature's processing over untold ages . . . mined, cleansed and graded by special refining at our plants, offers glass-makers Silica Sands of supreme quality.

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Kahle

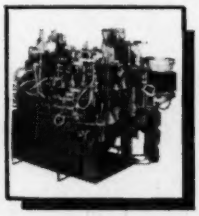
ANOTHER milestone in production techniques
ANOTHER instance of "Built-In Know-How"

This is not just another stem machine. It is a completely automatic stem machine with 24 heads and precision high speed index. The machine illustrated embodies all the improved techniques and mechanisms that Kahle engineers could find from their own and their customers' experience.

This problem involved glass tubulated stems for radio tubes. However, Kahle has solved many other problems neither associated with glass or connected with electronics.

If your problem requires special techniques or processes; if you need custom machinery; or, if you need relief from expansion projects, Kahle engineers will work with you to achieve "customer satisfaction" from "Built-In Know-How."

- Kahle Engineering Company has added one more outstanding piece of equipment to their constantly growing list of production equipment.
- A new 24 head Button Stem Machine No. 2179 for making one inch button stems with 8 wires and tubulation for T-9 tube sizes.
- Machine incorporates automatic lead wire feed, automatic tubulation feed, automatic glass bead feed, automatic unload. These, combined with automatic rejection and head cleanout in case any component fails to feed, make this machine unique.
- Such a machine is ideal for other similar stems such as cathode ray stems with 6, 8 or 10 wires.



Kahle ENGINEERING COMPANY
1314 SEVENTH ST. NORTH BERGEN, N. J.

This glassmaker checked Allmul performance by conducting side-by-side tests of this B&W electric-fused mullite brick and a semi-mullite brick. Allmul areas in the walls, floors and arches of four hot ports were still in excellent condition after more than a year. The result was a five carload order.

Here are some other reports

"How good is Allmul for burner blocks in hot ports? Our checks showed it gives four to seven times longer life than the firebrick previously used. We've ordered fifty Allmul burner blocks to date."

"After a year in port necks and uptakes, B&W Allmul's appearance was far superior to that of semi-mullite refractories. We are re-ordering Allmul in carload quantities."

Why not test B&W Allmul Firebrick for yourself? You, too, may profit from Allmul's extra-long service life which gives you longer campaigns. Most important, this durable, electric-fused mullite firebrick offers a remarkable economic advantage: it costs approximately as much as semi-mullite brick . . . yet equals the performance of other electric-fused mullite refractories costing substantially more.

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R427

B&W REFRACTORIES PRODUCTS—B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment... Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

GERMAN GLASS INDUSTRY . . .
(*Continued from page* 198)

Household Glass—Export Boom. Mechanization of pressed glass production progresses, but tableware is still produced in many variations by hand methods. More than half of these industries were originally located in the Eastern zone, but many foremen migrated and founded new organizations. This was not always done judiciously, as credit was public and local interests were manifold. Anyhow, the amount of companies in the West has doubled since 1945 (43:22). Eighteen of those are Bavaria (7 new). This branch employs 10,000 out of the 50,000 employed in the entire glass industry and produces about 70,000,000 marks (21%). It exports 30% of its production.

Illumination—Completely Relocated. This branch had to be completely reconstructed in the West (1950: 0, 1948: 3,500,000 marks, 1950: 13,000,000, 1951: 24,000,000), as it used to be concentrated in the East.

Optical and Technical—Moves to West of West. After the transfer of Jena to the Russian zone of occupation, new works were started in Zwiesel, Bavaria, 1946, where there was a small works. In 1951, 1,500 men worked in Schott's factories in Zwiesel, Landshut, and Mitterteich. In 1952, the works were centralized in the new factory in Mainz.

Fibers—Growth Still Ahead. A great expansion is expected. Now 20,000,000 marks worth of fiber glass are being produced annually.

Novelties, Jewelry, etc. ("Gablonz" Glass) — Spectacular Reconstruction by Emigrants. This special type of glass used to be produced exclusively in Gablonz (Czechoslovakia). In the best times between War I and II, 200,000,000 marks were obtained from foreign sales (98% of the production). The expulsion of the Sudeten Germans completely disposed of this industry in Czechoslovakia. Emigrants settled mostly in Bavaria, particularly in Kaufbeuren, and rebuilt this industry to the point that 60,000,000 marks were obtained for their production in 1950. Germany now has 940 factories, employing 11,000 men in this specialized industry, of which 650 with 8,000 people are in Bavaria, and again 500 with 5,000 people in the town of Kaufbeuren. About 20% of this production is exported. In 1951, 70,000,000 sales, with an export percentage of 45%, was probably obtained. The raw glass (30 tons daily) is produced in ten new works.

WYANDOTTE APPOINTMENT

The appointment of Norman Amend as assistant manager of Organic Chemicals of the Michigan Alkali Division of Wyandotte Chemicals Corporation, has been announced by Howard F. Roderick, Director of Sales.

Mr. Amend is a graduate of the Colorado School of Mines and joined Wyandotte in 1952 as a technical service representative. During the war, he served in the Engineers Corps and, immediately prior to joining Wyandotte, was in the special products department of the Buffalo Electric Chemical Company.

DuPont Glass Colors

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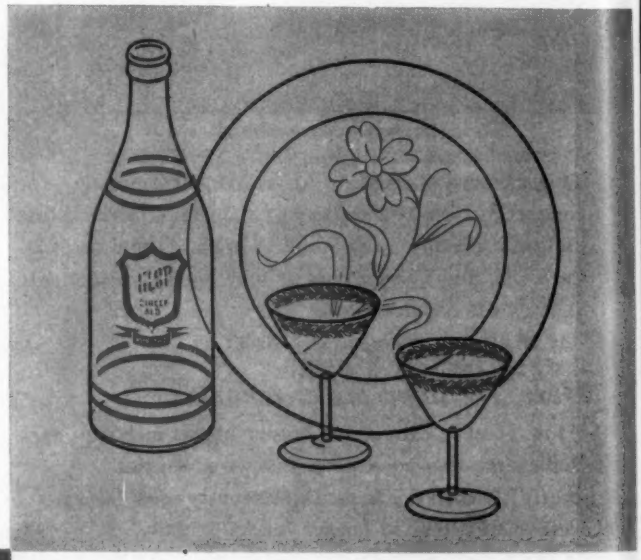
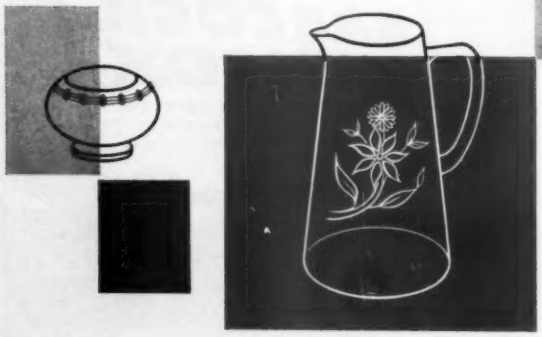
THERE'S a complete line of Du Pont glass colors for your decorating needs. Each of these durable colors is produced against a permanent standard . . . assures maximum coverage over a wide firing range. You can be sure of uniformity and sparkling appeal with all Du Pont colors . . . and, as always, Du Pont technical men will be glad to give you prompt assistance. E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Dept., Wilmington 98, Del.





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DU PONT GLASS COLORS

CHEMICAL USERS' GUIDE To General Chemical Products for the Glass and Ceramics Industries

PRODUCT	AVAILABLE FORMS	COMMERCIAL STRENGTH (MIN.)	SHIPPING CONTAINERS	APPLICATIONS
Hydrofluoric Acid HF + water	Liquid	60%, 70%	Steel Drums Tank Cars	Etching; Polishing; Frosting
Sulfuric Acid H_2SO_4 + water	Liquid	66° Be 93.19% H_2SO_4	Carboys Steel Drums Tank Trucks Tank Cars	Etching; Polishing Pickling Sheet Steel
Nitric Acid HNO_3 + water	Liquid	42° Be 67.18% HNO_3	Carboys Drums Tank Cars	Etching
Salt Cake Na_2SO_4	White Powder	99.5% Na_2SO_4 to 99.9% Na_2SO_4	Bags Bulk Carloads	Manufacture of Glass
Sodium Silicate $Na_2O \cdot X(SiO_2)$ + water *(Silicate of Soda)*	Viscous Liquid	38° to 52° Be Various Ratios of $Na_2O:SiO_2$	Drums Tank Trucks Tank Cars	Flux; Briquetting; Dispersing Agent
Sodium Fluoride NaF	White Powder Light or Dense	95% or 97% min. NaF	Multiwall Paper Bags Fibre Drums	Opacifier; Frosting Compounds
Sodium Silicofluoride $Na_2 \cdot SiF_6$	Powder	98% Na_2SiF_6	Bags Fibre Drums	Opacifier, Frosting Compounds
Sodium Acid Fluoride $NaF \cdot HF$ *(Sodium Bifluoride)*	White Powder	95% or 97% $NaF \cdot HF$	Fibre Drums	Frosting Compounds
Sodium Metasilicate $Na_2SiO_3 \cdot 5H_2O$	White Granules	29.0% Na_2O	Bags Fibre Drums	Cleaning Compound
Trisodium Phosphate $Na_3PO_4 \cdot 12H_2O$ *(TSP)*	Crystal	98.5-101% $Na_3PO_4 \cdot 12H_2O$ (Equiv. 19% P_2O_5)	Bags Fibre Drums	Cleaning Compound; In Opal Glass
Tetrasodium Pyrophosphate, Anhyd. $Na_4P_2O_7$ *(TSPP) (Pyro)*	White Powder	98% $Na_4P_2O_7$ (Equiv. 52% P_2O_5)	Bags Fibre Drums	Cleaning Compound; Conditioning Slip
Sodium Tripolyphosphate $Na_5P_3O_{10}$ *(Tripoly)*	White Powder	90-95% $Na_5P_3O_{10}$ (Total P_2O_5—56%)	Bags	Cleaning Compound; Conditioning Slip
Iron Sulfide FeS	Lump or Granular	90% FeS	Barrels Bulk (Carload)	Mfr. of Porcelains; Coloring Glass
Barium Fluoride BaF_2	Powder	98% Min. BaF_2	Drums	Opacifier
Magnesium Sulfate $MgSO_4 \cdot 7H_2O$ *(Epsom Salt)*	Crystal	To meet U.S.P. Specs. (99.5% $MgSO_4 \cdot 7H_2O$)	Bags	Conditioning Slip
Hydrochloric Acid HCl + water *(Muriatic Acid)*	Liquid	18° Be, 20° Be, 22° Be	Carboys Tank Trucks Tank Cars	Pickling Sheet Steel
Disodium Phosphate, Anhyd. Na_2HPO_4	Powder	96% Na_2HPO_4 (Equiv. 48% P_2O_5)	Bags Fibre Drums	In Opal Glass; Conditioning Slip

The products advertised are commercial chemicals having various uses, some of which may be covered by patents, and the user must accept full responsibility for compliance therewith.

OTHER PRODUCTS: Alum; Ammonium Sulfate; Cobalt Nitrate; Alkali Fluoborates; Sodium Silicofluoride.
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"IF IT'S MADE OF GLASS, ASK US FIRST"

CURRENT STATISTICS . . .

(*Continued from page* 215)

cent over the 3,652,091 dozens sold during January. Sales during February 1952 were 3,857,152 dozens. At the end of the 12-month period ending February 1953, sales totalled 41,582,550 dozens. This is 6.7 per cent over the 38,970,509 dozens sold during the same period in 1952.

SOUTHEASTERN OPTICAL NAMES VICE PRESIDENT

The election of Albert T. Vannerson, Atlanta District Manager, to Vice President of Southeastern Optical Company has been announced by Walter S. Galeski, President.

Mr. Vannerson, who was promoted to District Manager in 1948 after serving as a salesman and Atlanta Branch Manager, was elected to the post at the annual meeting of directors of the company.

DIAMOND ALKALI ANNOUNCES PRICE INCREASE

Diamond Alkali Company has announced price increases for soda ash and chlorine, effective April 1, but because of possible continuance of federal price controls until April 30, the new prices will be applicable only on shipments made on or after May 1.

Prices of carload soda ash, both light and dense, will be increased 15 cents per hundred pounds both in bulk and packages. On chlorine, prices are increased 20 cents per hundred pounds in single unit tank car deliveries.

THE SHARP-SCHURTZ COMPANY

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Need for production: Simpson Mixer, Raymond Mill, one or two Vibrating Screens. Please give full particulars. P. O. Box 1351, Church Street Station, New York 8, New York.

FOR SALE

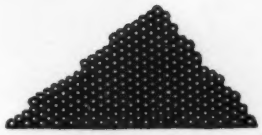
TWO used 8-head Ambeg type ampul machines 1cc to 10cc capacity. Excellent condition. Novocol Chemical Mfg. Company, Inc., Brooklyn, N. Y.

WESTINGHOUSE NAMES RESEARCH HEAD

Dr. Charles M. Slack has been named Director of Research and Engineering of the Westinghouse Lamp Division at Bloomfield, New Jersey. He has been assistant manager of the Westinghouse Atomic Power Division in Pittsburgh for the past three years and will continue to be available as a consultant to that division in addition to his new duties.

Dr. Slack joined Westinghouse in 1927 following a teaching position at Columbia University, from which he holds his M.A. and Ph.D. degrees.

• Bryan Rudder, formerly a sales engineering supervisor with the A. P. Green Fire Brick Company, has been appointed a direct salesman for the Philadelphia office of that company. Mr. Rudder recently graduated from the University of Missouri with a degree in civil engineering.



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